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REACHBACK OPERATIONS FOR AIR CAMPAIGN

PLANNING AND EXECUTION

by

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Air campaign planning and execution are two extremely complex tasks in modern warfare. Each day during a major regional contingency, thousands of sorties from dozens of bases must be choreographed for maximum effect against the enemy to carry out the Joint Force Commander?s intent, in concert with other friendly military activities. Today, the Contingency Theater Automated Planning System (CTAPS) assists this task, using a large assortment of modern computer tools. Although CTAPS is an enormous improvement over previous planning and execution methods using paper charts and grease pencils, deficiencies in survivability, deployability, and supportability remain regarding the way the Joint Air Operations Center (JAOC) implements CTAPS, otherwise known as the CTAPS architecture. However, emerging communications capabilities, coupled with existing or emerging distributed data processing technologies, promise to improve these three deficiencies through Reachback operations using datalinked, but geographically separated computer workstations to allow most of the JAOC?s personnel and equipment to remain in a secure location, rather than deploying forward in the theater. This paper describes CTAPS and its architecture deficiencies; as well as a conceptual Reachback system, along with its advantages and drawbacks. Finally, the paper recommends the DOD, through the services, develop a Reachback system for the JAOC.

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Preface

Inspiration for this research hit me long before I entered the Air War College. I became enamored with the possibility of applying Reachback operations to air campaign planning and execution while reading Williamson Murray's *Air War in the Persian Gulf,* and Edward Mann's *Thunder and Lightning: Desert Storm and the Airpower Debates.* These books chronicle how General Horner and his staff overcame tremendous challenges during Desert Shield and Desert Storm to orchestrate an air war unique in human experience. General Horner's difficulties convinced me of the absolute necessity of avoiding the problems of survivability, deployability, and supportability for future Joint Air Operations Centers (JAOC) through advanced communications and computational technologies. My conviction is certainly not unique, or even original; many talented warfighters and computer system developers have worked for years to implement geographically distributed data processing for the JAOC. Much of their work truly pushes the state-of-the-art to create innovations in real-time Air Tasking Order generation as well as distributed data processing. Hopefully, my paper will make two contributions: first, to analyze Reachback operations for the JAOC, and second, based on this analysis, to argue for implementing such a system in the near-term using today's technologies, then upgrading as appropriate when advanced research and development allows.

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Abstract

Air campaign planning and execution are two extremely complex tasks in modern warfare. Each day during a major regional contingency, thousands of sorties from dozens of bases must be choreographed for maximum effect against the enemy to carry out the Joint Force Commander's intent, in concert with other friendly military activities. Today, the Contingency Theater Automated Planning System (CTAPS) assists this task, using a large assortment of modern computer tools. Although CTAPS is an enormous improvement over previous planning and execution methods using paper charts and grease pencils, deficiencies in survivability, deployability, and supportability remain regarding the way the Joint Air Operations Center (JAOC) implements CTAPS, otherwise known as the CTAPS architecture. However, emerging communications capabilities, coupled with existing or emerging distributed data processing technologies, promise to improve these three deficiencies through Reachback operations using data-linked, but geographically separated computer workstations to allow most of the JAOC's personnel and equipment to remain in a secure location, rather than deploying forward in the theater. This paper describes CTAPS and its architecture deficiencies; as well as a conceptual Reachback system, along with its advantages and drawbacks. Finally, the paper recommends the DOD, through the services, develop a Reachback system for the JAOC.

Chapter 1

Introduction

To one man a god has given deeds of war.

—Homer, c. 700 BC.

War is perhaps the oldest endeavor of mankind, and in modern times, certainly the most complex. Desert Storm's air campaign illustrated this complexity, for 2,400 coalition aircraft flew day and night with precise synchronization from over 20 airfields and 6 Navy carriers.[1] For most of these sorties, air campaign planners specified the missions, types of ordnance or cargo, targets, flight paths, refueling tracks and off-loads, and many other parameters essential for success. Daily, the planners had to choose hundreds of targets, maximizing progress toward the Coalition's objectives, while at the same time minimizing the risk to the aircrews and ground forces, as well as the risk to enemy civilians, religious and historical buildings, and other proscribed sites. Few peacetime undertakings could match the Herculean task of planning and executing the Coalition's air campaign.

What tools did the planners have for this daunting task? Despite over 3,000 computers in the war zone data-linked to computers in the United States,[2] much of this excruciating work was "conducted as it had been for decades: with paper charts and grease pencils."[3] Lt Gen Charles A. Horner, the Desert Storm Joint Force Air Component

Commander (JFACC), overcame the shortcomings of these methods by canvassing the Air Force for Fighter Weapons School graduates to be the nucleus of his planning staff, forming the aptly named "Black Hole." These experts, as well as the entire JFACC staff, did what was necessary with available computer tools, such as the Computer Aided Force Management System.[4] As this paper explores in depth, today's advanced data processing and communications technologies promise to transform air campaign planning and execution far beyond the rudimentary tools available to General Horner.

Since the late 1980s, the Air Force has been developing an integrated set of computer hardware and software tools to lessen the air planner's burden. These computer tools are collectively known as the Contingency Theater Automated Planning System (CTAPS). To better understand CTAPS, Chapter 2 first describes the Joint Air Tasking Cycle, the set of ordered activities CTAPS supports. The chapter then explains how CTAPS works, providing an overall understanding of the tasks involved, as well as defining the vocabulary unique to air campaign planning and execution. The way the Joint Air Operations Center (JAOC) implements CTAPS, also referred to as the CTAPS architecture, requires a large number of people and extensive amount of equipment in the theater. Unfortunately, the CTAPS architecture's large size and in-theater location lead to poor survivability, deployability, and supportability. In addition to explaining CTAPS, Chapter 2 also explores these deficiencies, as well as other, less serious shortcomings of the current CTAPS architecture.

Chapter 3 introduces a possible solution to these CTAPS architecture deficiencies. This improvement relies on advanced communications and distributed data processing to break up a complex computational task into subtasks performed by data-linked, but

geographically separated computers, often simultaneously and synergistically. Businesses and the Department of Defense (DOD) do this all the time. In fact, the Air Force's Tactical Air Command headquarters at Langley Air Force Base (AFB), Virginia used a similar Reachback concept extensively during Desert Storm to assist General Horner in his administrative duties as commander of all Air Force personnel in the theater.[5] Since Desert Storm, new data communications technologies offer the JFACC the option of leaving most CTAPS computer systems and operators in either a continental United States (CONUS) garrison, or in another rear area. Only the JFACC, along with a much smaller supporting staff and much less equipment, need be at risk in the theater. Such a capability is often called *Reachback operations.* This paper uses the term *Reachback system* to refer to a conceptual air campaign planning and execution system embodying a Reachback operations capability.[6] Chapter 3 explores what hardware and personnel should deploy to the theater for a major regional contingency, and what/who should stay in a secure garrison. This chapter then points out the factors for deciding where the garrisoned segment should reside. Finally, Chapter 3 discusses the rapidly evolving US communications capabilities which make Reachback operations possible.

Based on the conceptual system introduced in Chapter 3, Chapter 4 examines the advantages of Reachback operations. To be clear, a Reachback system using advanced communications to implement geographically distributed data processing will not, by itself, improve CTAPS' functionality. In an ideal world with neither threats nor logistics constraints, the most effective CTAPS architecture would colocate all the equipment and operators in a large, unpartitioned room in the theater to maximize synergism among the CTAPS components and to keep the air planners close to the war. However, a Reachback

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system's improved survivability, deployability, and supportability would make it far preferable to the current, centralized CTAPS architecture. Overall, because of these three advantages, Reachback operations would directly support the new DOD vision of expeditionary warfare underpinned by information superiority.[7] Other ancillary advantages also derive from using Reachback operations. Databases of intelligence information, terrain, current forces, and many other critical factors could be standardized for all services employing air assets. A Reachback system could also alleviate a number of problems faced by a JFACC operating aboard ship, and should make the transition between a JFACC afloat and a JFACC ashore less complex than is the case today. Another ancillary benefit of a stable garrison location may include the opportunity for its personnel to gain more proficiency than currently possible, because larger numbers of civilian operators and system administrators could be employed alongside the military staff. Finally, depending on the number of garrisoned locations, the Reachback system's infrastructure could feature less equipment duplication, compared to today's multiple JAOC force structure. Improved survivability, deployability, and supportability, as well as the five secondary benefits, suggest that investing in Reachback systems is compelling indeed.

Of course, Reachback operations, no matter how compelling the case, are not without drawbacks. Both human proclivities and the system's geographically distributed architecture present impediments. Chapter 5 explores these disadvantages and, where possible, suggests avenues for mitigating the adverse consequences of Reachback operations. In particular, the following concerns could impede successful operation of a Reachback system: reservations from senior officers, communications dependencies,

lower operational efficiencies requiring additional personnel and equipment, leadership challenges for garrisoned personnel, and difficulties in incorporating theater-produced intelligence into the garrison's databases. Although none of these drawbacks should be taken lightly, mitigating possibilities exist for virtually all of these concerns. Even more important, no insurmountable obstacles exist for implementing a Reachback system.

Finally, Chapter 6 recaps this paper by summarizing the case for Reachback operations becoming the mainstay of air campaign planning and execution, then recommending specific actions required to implement a Reachback system.

Notes

[1] Williamson Murray, *Air War in the Persian Gulf,* (Baltimore, Md.: The Nautical & Aviation Publishing Company of America, 1995), 12, 41.

[2] Alan D. Campen, *Information War*, (Fairfax, Va.: AFCEA International Press, 1992), 33, quoted in Lt Col David R. Stinson, "Improved Air Campaign Planning Through Cybernetics and Situation Control," (Mershon Center Program for International Security and Military Affairs Paper, Ohio State University, May 1995), 7.

[3] Nick Cook, "USA Plots Mission Support Revolution," *Jane's Defense Weekly*, 19 November 1994, 29, quoted in Stinson.

[4] Lt Col Thomas R. Gorman, JFACC Training Program Director, USAF Air Ground Operations School, Hurlburt Field, Fla., to author, electronic message, subject: Review of Reachback Paper, 5 March 1997.

[5] Lt Gen (Ret) Stephen B. Croker, interviewed by author 20-21 February, 1997.

[6] Carl DeFranco of Rome Laboratory, in conjunction with the Defense Advanced Research Projects Agency, is developing a system employing a distributed data processing version of CTAPS. This system is called the Distributed Air Operations Center (DAOC). This paper avoids using Rome Laboratory's terminology, since the DAOC is a specific hardware and software configuration capable of Reachback operations, not a conceptual system as discussed in Chapters 3-5.

[7] Chairman of the Joint Chiefs of Staff, *Joint Vision 2010,* 1996, 19.

Chapter 2

The Contingency Theater Automated Planning System

It is a bad plan that admits of no modification.

—Publilius Syrus, First Century BC.

The need for flexible planning in war has been evident for millennia. Air campaign planning and execution illustrate this maxim. Airmen must choreograph numerous, disparate air assets to achieve the Joint Force Commander's (JFC) objectives. Therefore, centralized control has been the Air Force's doctrinal foundation ever since the costly lessons from Tunisia during World War II, when disjointed Airpower failed to mass against the enemy wherever most needed throughout the theater.[1] A less renowned, but equally important lesson from Tunisia was the need for synergistic cooperation among the air and ground combatants.[2] The Navy had already learned the need for maritime air and surface force coordination as it developed carrier air doctrine in the 1930s. Thus, planning and executing modern air campaigns concerns itself not only with large numbers of aircraft, but also with fast changing circumstances and objectives as war, both on the ground and at sea, progresses.

Even before Desert Storm, the Air Force recognized the need for a new generation of automated tools to assist planners in being more responsive. In the late 1980s, the Air Force started the CTAPS program. Eventually, it became an evolutionary development

based on extensive operator interaction with prototype tools at Langley AFB, Virginia.[3] CTAPS is still evolving as new technologies open up possibilities to better support the JAOC staff. To illustrate how many iterations the design has undergone, version 5.2 is slated for release to the field soon.[4] The Air Force plans to incorporate CTAPS into the Theater Battle Management Core Systems, and eventually to provide the CTAPS capability within the Global Command and Control System environment.[5]

This paper first focuses on CTAPS. Even though the CTAPS components could readily accommodate worldwide distributed processing, the current CTAPS architecture does not use long distance communications as would a Reachback system. On the other hand, CTAPS is the result of years of evolutionary growth in automated tools for air campaigns. Further, the DOD has embraced CTAPS' successors for joint procurement and operations. Thus, the CTAPS core capabilities discussed in this chapter will undoubtedly have a long legacy in follow-on systems, including Reachback systems. Chapters 3 and 4 build upon the material in this chapter regarding how air campaigns are conducted today. To better understand CTAPS, a brief review of the Joint Air Tasking Cycle, based upon Joint Publication 3-56.1, Command and Control for Joint Air Operations, would be helpful.

The Joint Air Tasking Cycle

Modern air campaigns operate in a battle rhythm to accomplish all required activities in a logical order. Although the Air Tasking Order (ATO) is a key, and perhaps best known, product of this cycle, all major activities produce important data products. According to Joint Publication 3-56.1,

The [Joint Air Tasking] cycle provides a repetitive process for the planning, coordination, allocation, and tasking of joint air missions/sorties, within the guidance of the JFC. There are usually three joint ATOs at any time: (1) the joint ATO in execution (today's plan), (2) the joint ATO in production (tomorrow's plan), and (3) the joint ATO in planning (the following day's plan).[6]

Figure 1 diagrams the principal steps in the Joint Air Tasking Cycle.
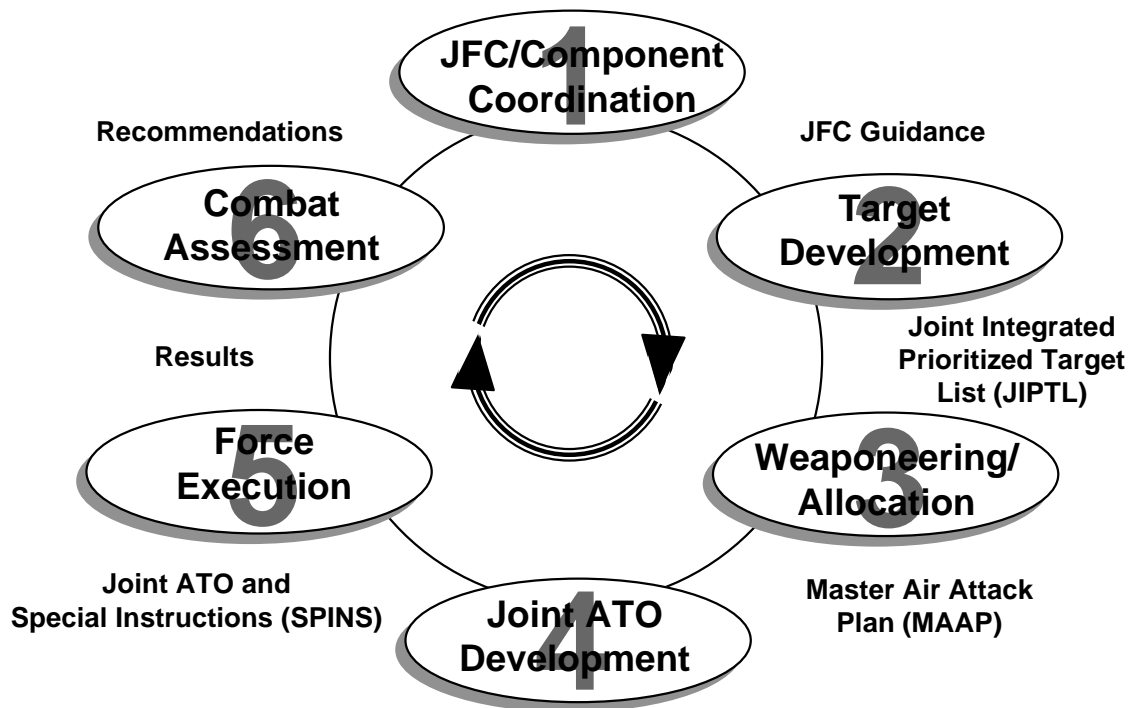
Source: Joint Publication 3-56.1, *Command and Control for Joint Air Operations* (14 November 1994), IV-4.

Figure 1. Joint Air Tasking Cycle

The JFC's procedures dictate how long this cycle requires for each of the three ATOs in work at any one time. If the time to complete this cycle takes longer than the enemy's decision cycle, the JFACC staff will get further and further behind the war, thereby diminishing airpower's attributes of speed and flexibility. A short description of each

major step in the Joint Air Tasking Cycle follows.[7] For clarity, many details have been left out; only the top-level actions are addressed.

Coordination Between the Joint Force Commander and the Components

This step starts off a new cycle. The JFC considers the implications from the most recently completed combat assessment, and with the advice of the component commanders for air, land, and maritime forces, issues guidance and objectives for the next cycle. To illustrate, if air superiority has largely been achieved, then the JFC might decide to place greater emphasis on air interdiction objectives.

Target Development

With the JFC's guidance and objectives understood, the component commanders then nominate to the JFACC targets they cannot attack with their own assets. Targets may also come from previously defined joint target lists, intelligence reports, and electronic warfare inputs. The JFACC prioritizes all these potential targets to best support the JFC. The Joint Integrated Prioritized Target List (JIPTL) documents the JFACC's recommendations to the JFC for the detailed planning to follow.

Weaponeering Allocation

Based on the JFC-approved JIPTL, targeting personnel match types and numbers of aircraft and weapons to targets, as well as target aim points and other critical mission planning factors. This information compiles into the Master Air Attack Plan (MAAP). The JFACC, and perhaps even the JFC, will review the MAAP to ensure it addresses the JFC's guidance and objectives. The MAAP forms the foundation for the ATO.

Joint Air Tasking Order Development

JAOC planning continues to turn the high-level MAAP into the detailed ATO by generating directions sufficient for assigned forces to plan and execute their missions. Some tasks, such as determining fuse types and settings, are normally accomplished by the wing planning cells, not the JAOC.[8] If only a small number of units are involved, the ATO would be a relatively short message to the tasked units. For large operations requiring precise coordination among many units, ATOs must be commensurately more lengthy. For example, ATOs during Desert Storm were typically 600 pages long, containing mission data for 3,000 sorties.[9] Joint ATO Development also generates Special Instructions (SPINS) and the Airspace Control Order (ACO) to assist aircrews in completing their missions safely without interfering with other military operations.

Force Execution

As its name implies, this step in the Joint Air Tasking Cycle involves carrying out the missions assigned by the ATO. An important aspect of this activity is the real-time redirection of previously planned sorties to react to time sensitive tasks. A classic example of real-time redirection occurred on the night of 30 January, 1991. Based on real-time warning from a Joint STARS aircraft,[10] General Horner's staff retasked over 140 tactical aircraft sorties to interdict an Iraqi attack on Khafji, Saudi Arabia. These sorties were decisive, for "the Iraqis had received such devastating blows from the air around Khafji that they had no intention of moving again; nor did they for the rest of the air war."[11] While the Joint Air Tasking Cycle as a whole may appear ponderous, the force execution step gives the JFACC the ability to react immediately to a fluid operational situation.

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Combat Assessment

This is the final, and most critical step in the cycle. Combat assessment determines what happened during force execution, evaluating not only the results of friendly sorties, but also enemy actions and other changes in the JFC's area of responsibility. Experience points to this as the most problematic activity in the Joint Air Tasking Cycle.[12] Combat assessment used to be called "bomb damage assessment," but as the current name implies, all combat activity should be analyzed, not just bombing results. The products of this step are reports and recommendations for the JFC to consider when the next cycle begins.

Contingency Theater Automated Planning System Tools

CTAPS is an integrated set of tools partially automating the activities of the Joint Air Tasking Cycle. In this context, the term *tool* refers to a software program and its associated hardware, such as the Sun Microsystems® SUN SPARC workstations CTAPS typically uses.[13]

Figure 2 indicates what step(s) of the Joint Air Tasking Cycle each primary CTAPS tool assists, using standard acronyms for each tool.[14] Subsequent paragraphs will briefly describe these tools. With the sole exception of the JFACC Planning Tool, all of these computer programs freely interchange their data and products, so that any operator can call up any information available throughout CTAPS. Actually, CTAPS contains over 150
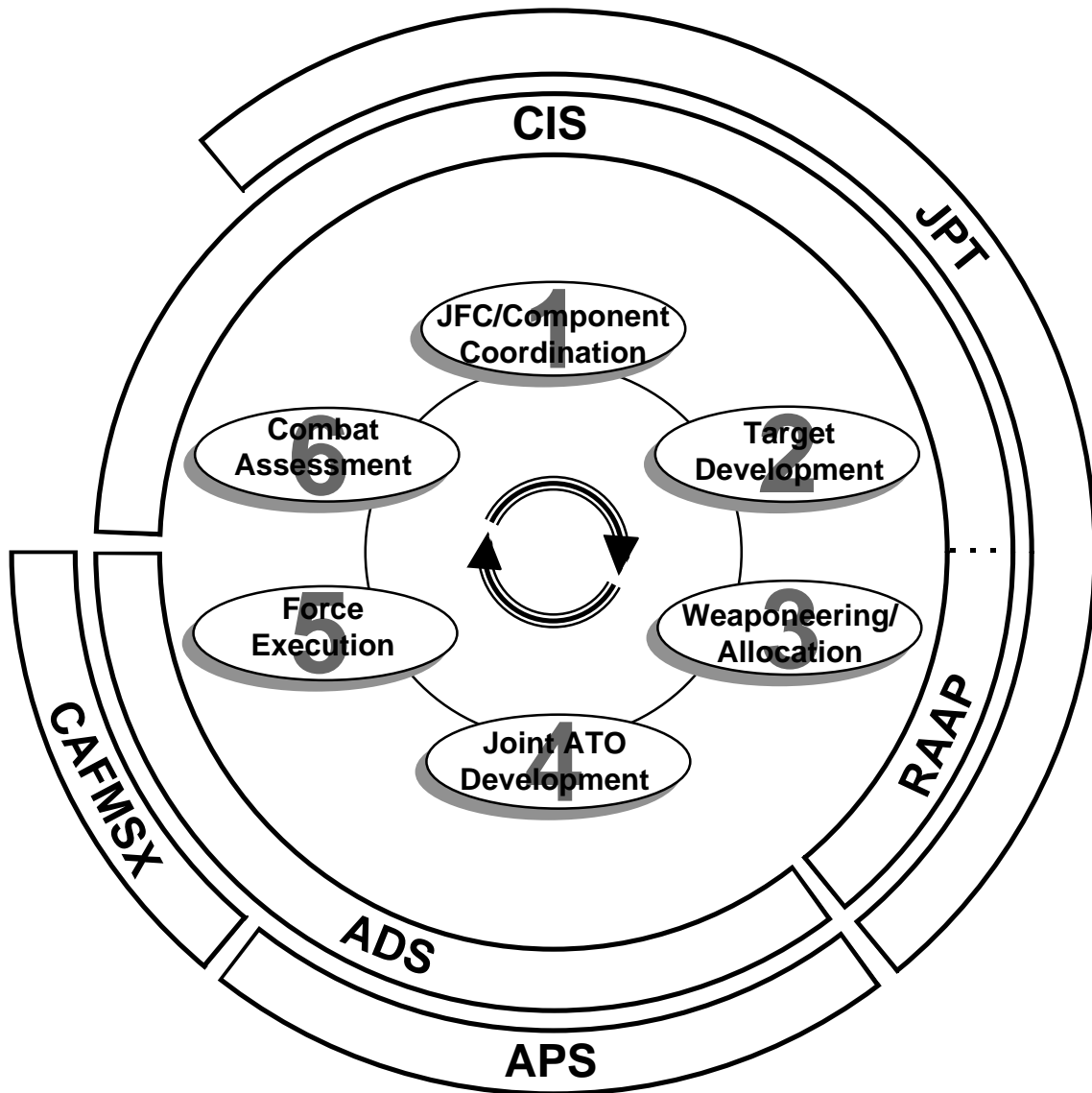
Figure 2. CTAPS Tools for the Joint Air Tasking Cycle

tools. For clarity, Figure 2 shows only the primary CTAPS tools, leaving out other tools,
such as message handlers. Any CTAPS workstation can access any tool for appropriately
designated operators,[15] although most operators specialize in using one of the primary
tools described below.

One of CTAPS' attributes is its flexibility to size the number of workstations to fit
the nature of the contingency. The following paragraphs relate the number of

workstations each tool might require for a major regional contingency, such as Desert Storm. A contingency with a smaller scope would generally use fewer workstations than the numbers quoted below.

Advanced Planning System (APS)

The APS tool assists planners in developing the ATO. The APS database contains theater data, such as aircraft types, radar locations, and digital maps; scenario data, such as the JFC's guidance, logistics status, and nominated targets; and the Air Battle Plan, an electronic version of the ATO. The APS not only maintains all this data, but it also assists the planners in generating new data for upcoming ATOs.[16] The DOD has designated the APS as the standard joint planning tool. For a large contingency, APS might use 36 workstations, with a minimum of one workstation for each aircraft type.[17]

Airspace Deconfliction System (ADS)

The ADS tool helps generate the Airspace Control Order (ACO) to deconflict the allocated airspace blocks for military forces in the theater, not only for aircraft, but also for surface-to-air missiles and cruise missiles.[18] Up to eight workstations can manipulate the ADS database, although most of the other CTAPS workstations would also typically access ADS products.[19] Due to the size of the ADS database these machines manipulate, all eight should be located together.[20]

Combat Intelligence System (CIS)

Accurate, timely intelligence information is critical to CTAPS. CIS receives, analyzes, displays, and distributes intelligence data from multiple sources. CIS can extract data from the Defense Intelligence Agency's database. CIS also maintains its own

theater database, and allows access by wing-level intelligence workstations.[21] CIS is a

large system. For a major regional contingency, perhaps 50 workstations may be devoted

to this task; however, CIS workstations do not require colocation.[22]

Computer Aided Force Management System X (CAFMSX)

The CAFMSX tool monitors and displays both offensive and defensive air operations

status. With it, the JAOC keeps track of mission status for each sortie.[23] In addition,

CAFMSX links the JAOC to geographically separated wings equipped with their own

CAFMSX workstations. CAFMSX can distribute ATOs to the wings in seconds, rather

than the many hours experienced in the early days of Desert Shield.[24] Like CIS,

CAFMSX has a large allocation of workstations within the JAOC. A major regional

contingency would use 40 workstations; however, also like CIS, CAFMSX workstations

do not need to be colocated.[25]

JFACC Planning Tool (JPT)

The JPT helps the JFACC keep track of national strategic objectives, the JFC's

theater objectives, air campaign objectives, air tasks, and targets, providing tractability

from each target and air task all the way back to the national objectives. The JPT

assesses threats, develops and evaluates alternatives, and estimates the size and

composition of the air assets necessary to reach these objectives. The JPT can export its

target list to the RAAP (discussed below), and create a draft MAAP as well,[26] although

the JPT is not yet integrated into the suite of CTAPS tools.[27] Currently, the JPT handles

offensive counterair, strategic attack, air interdiction, and close air support missions. In

the future, the JPT will also encompass force enhancement and force support missions,

and will be integrated with the other CTAPS tools. For now, the JPT requires two displays, one processor, and many disk drives for data storage.[28]

Rapid Application of Airpower (RAAP)

Actually, the RAAP tool is a part of the CIS, but the RAAP's function is sufficiently important that it is highlighted as a separate tool. RAAP helps planners define targets and choose appropriate weapons. Also, RAAP stores the history of each target, including when the target was attacked, what the attack results were, state of repairs since the attack, and so forth.[29] RAAP requires a more modest number of workstations than either CIS or CAFMSX. Typically, ten workstations connected to a server run the RAAP.[30]

Shortcomings Of The CTAPS Architecture

Despite its obvious technology leap over "paper charts and grease pencils," the CTAPS architecture still requires a large amount of manpower and equipment deployed in the theater, making it vulnerable to attack, and difficult to deploy and support.[31] The following paragraphs discuss the shortcomings stemming from CTAPS' size and in-theater location.

Survivability

If an asset takes up a lot of space, requires many people, or has an easily detectable signature, it is said to have a large footprint. Even in the theater's rear area, the CTAPS-equipped JAOC has very large electronic and physical footprints, making it a relatively vulnerable target to air raids, missile attacks, guerrilla actions, or sabotage. These threats could either damage the JAOC directly, or indirectly by crippling the infrastructure supporting the JAOC (for example, electrical power or communications links). According

to an experienced former JFACC, Lt Gen (Retired) Stephen B. Croker, either the loss of highly trained personnel or the loss of the JAOC's critical air combat planning capabilities are extremely serious concerns for a JFACC.[32]

As General Horner observed, "The American people have demonstrated unbelievable tolerance at the losses of sons and daughters in battle when they believe in the cause, but no President or general can overestimate the speed at which that patience will disappear if they are perceived to be spending lives foolishly. Public sensitivity to casualties can dominate our political and military decision-making in a crisis."[33] For a variety of reasons, the United States has become averse to wartime casualties, so placing many hundreds of people in harm's way must be avoided if possible.

From a strategic perspective, losing the JAOC's capabilities during wartime would be even more of a blow than sustaining a large number of casualties among the JAOC staff. Incapacitating the JAOC would be tantamount to putting the coordinated air war on hold until a new JAOC could be constituted. By and large, the types of sorties flown would be restricted to whatever could be controlled by the ground or maritime component commanders, reminiscent of the less than exemplary operations in Tunisia during World War II. The resulting drastic loss of effectiveness would not only set back the war effort, but would also undoubtedly result in more friendly casualties over and above any initial loss of life when the JAOC was attacked. Indeed, an adversary would be well advised to consider the JAOC a preeminent center of gravity when planning to attack US forces.[34]

Deployability

A JAOC equipped with CTAPS is extremely difficult to deploy. Today, fully deploying a JAOC requires 41 C-141 loads to carry the equipment, in addition to 3

widebody airliners required to deploy the 900 people needed to operate the JAOC.[35] During a major regional contingency like Desert Storm, airlift is always in short supply,[36] so the burden of quickly transporting a JAOC with its CTAPS is truly onerous.

Because of the massive lift required, deployment timelines suffer. Deployment schedules are also lengthened due to the need for extensive JAOC personnel augmentation, since without augmentation, the numbered air forces cannot mobilize beyond a small, quick reaction package.[37] Like airlift and skilled personnel, reaction time during a crisis is always in short supply. Recalling the frantic activity of Desert Shield, General Horner observed:

> We were surprised at Pearl Harbor, in Korea, and again in the Gulf. Iraq's invasion of Kuwait took us completely by surprise. I will never forget those long dark nights in August 1990 when we struggled desperately to build up our forces Fortunately, Saddam stayed put in Kuwait, and the rest, as they say, is history. But he and other potential aggressors learned a valuable lesson: *Don't give America six months*. (Emphasis added)[38]

Because the United States is the sole superpower with global commitments, in the future the number and variety of crises requiring US military forces will probably increase.[39] In all likelihood, America's next major military confrontation will require forces ready to fight far sooner than the JAOC deployment lead time can support. In such a scenario, the JFACC may have little choice but to depend on either a ship-based or a CONUS-based CTAPS until the JAOC is operational ashore in the theater.

During the Cold War, the United States depended on forward basing and prepositioning to prepare theaters where conflicts were likely. However, the end of the Cold War precipitated a reduction of US military bases on foreign soil and a withdrawal of most American forces to the CONUS.[40] In effect, US military forces are returning to

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their pre-Cold War heritage, albeit with a greater expeditionary capability than existed in the past.[41] Although the United States still maintains prepositioned war materiel, sophisticated and expensive systems such as CTAPS are typically kept at home, both for physical security and for daily use during training and exercises. If the United States must fight, it may well not have the luxury of a prepared theater with a CTAPS-equipped JAOC already in place, thereby accentuating the deployment difficulties posed by this unwieldy equipment.

Supportability

Even if JAOC deployment problems could be overcome, supportability difficulties remain. Providing facilities and supplies for 900 people in an operational theater is not trivial; however, 41 C-141 loads of high-technology CTAPS and other JAOC equipment pose an even larger supportability challenge. Even though CTAPS was not operational during Desert Storm, deploying similar equipment during that conflict illustrated the magnitude of the supportability challenge. Computers, generators, and other sophisticated equipment broke regularly due to the harsh climatic conditions, and spare parts or replacement equipment were literally half a world away.[42] Unfortunately from a reliability perspective, cost and availability will continue to dictate commercial standards for most of the equipment in the JAOC. Rugged handling during deployment sometimes proves to be too much of a challenge for commercial quality equipment. After the equipment is installed, dust, grit, and humidity are often problems even in an environmentally controlled facility, not to mention the far less hospitable environment deployed equipment usually sees. Service on-site is usually not feasible; after all, the

theater is a war zone. The only viable maintenance option is to fly in replacement units, thereby adding to the airlift burden.

Other Ancillary CTAPS Architecture Deficiencies

In addition to the three serious shortcomings described above, five ancillary CTAPS deficiencies exist. Unlike the first three problems, these five ancillary deficiencies are not in themselves sufficient motivation to invest in a Reachback system. However, if a Reachback system were to be procured, the developers should pay attention to improving the following areas.

Database Standardization

CTAPS databases are enormous, as well as enormously important. Databases contain the JFC's guidance and direction, friendly and enemy force dispositions and status, target vulnerabilities, aircraft capabilities, weapons effects, terrain data, political boundaries, surface and foliage composition, current and predicted weather, climatology, supply status, combat assessments, air-to-air refueling orbits, and much other vital knowledge. These and a host of other topics are all crucial to modern air warfare.[43] Not surprisingly, these same databases are equally important to other services conducting their own operations. Unfortunately, Air Force databases are often not compatible with those of other services.[44]

Database incompatibilities can be disastrous. For example, during a recent Roving Sands theater missile defense exercise, Air Force and Marine Corps missile warning grid coordinate systems were different, so that Air Force warnings to Marine units of incoming missile attacks were confusing until correct grids were obtained. This situation

illustrated the opportunities for confusion even in a well planned military operation, particularly since before the Roving Sands exercise, Air Force and Marine staffs anticipated the possibility of incompatible coordinates, and worked closely together to avoid this problem.[45] Although the DOD has designated the APS as a joint service standard, the Air Force, Navy, and Marines all have different systems for directing air campaigns. The accompanying database incompatibilities are truly a significant problem.

Support for the JFACC Afloat

Joint Publication 3-56.1 specifies that the JFACC may be stationed on a ship if the situation in the theater makes this location advantageous.[46] If so, the JFACC would normally be either on an aircraft carrier or on a command and control ship. More planning staff, computer tools, and communications are available to the JFACC on a command and control ship than on an aircraft carrier. Even so, a command and control ship's communications capabilities and deck space limit the JFACC staff to about 280 personnel, with the number of automated tools similarly restricted.[47] These space limitations are unlikely to ease in the future, since a new class of ships would have to be built to provide significantly more room and facilities. Even though CTAPS has been adapted for these command and control ships, a JFACC afloat is currently limited to planning and executing about 800 sorties per day,[48] only one quarter of the sorties a major regional contingency may require.

Transition between JFACCs Afloat and Ashore

Any JAOC staff member will attest to the enormous difficulties in transitioning the planning and execution authority between a JFACC afloat and a JFACC ashore. Such

transitions (usually, but not necessarily in the direction from ship to shore) are perhaps the toughest tasks these staffs will ever perform.[49] The two problems discussed immediately above both contribute to this situation. Because the databases are not quite the same, and because the supporting automation differs between ship and shore, JAOC staffs have learned to expect a lot of hard work, and more than a little pandemonium whenever JFACC authority transitions. The result may be one or more days during the transition when a new ATO cannot be issued, a potentially serious situation during combat.[50]

Operator Proficiency

As noted above, the numbered air forces cannot deploy and operate a JAOC for a major regional contingency without augmenting the permanent staff with personnel from other JAOCs and from subordinate units. Although augmentees may receive some training, in most cases their proficiency must come from on-the-job experience, hardly a desirable situation in the middle of a war. Even "permanent" military members of the designated battle staffs rotate to other assignments every two to four years, resulting in about one-third of the staff being new at any given time. In many other occupational specialties, the Air Force relies on civil servants to provide continuity, but operating CTAPS in a war zone severely limits the number of civilians staffing the JAOC. As a result, the first time the JAOC staff must prepare a real-time ATO, it is less than affectionately called "the ATO from hell."[51] Eventually, the JAOC staff will gain proficiency, but the staff will never be able to go back in time and refight the early days of the war, when the adverse consequences of inexperience may be the most costly.

Configuration Control

Potentially, at least 28 US military organizations have the mission to operate a JAOC.[52] Even though some of these units have limited capabilities and equipment, this figure still represents a sizable investment in personnel and hardware.   CTAPS configuration control is a thorny problem not only because of equipment dispersion, but also because some of these 28 units cannot afford to change their hardware configuration often enough to keep up with the turbulent electronics industry. Consequently, some organizations use state-of-the-art CTAPS equipment, while other organizations lag by a computer generation or two.

This turbulence makes configuration control for data processing systems a huge undertaking. What is state-of-the-art today may not even be supportable tomorrow. As a consequence, when the DOD buys commercial data processing systems, it also makes an implicit (although sometimes unrecognized) decision to replace those systems every two to three years to keep them maintainable and compatible with other systems.   The configuration control challenge turns into a near impossibility when equipment is dispersed throughout the world, responsibility for upgrading it is scattered to each unit owning the equipment, and unit budgets are squeezed to the point that new equipment is unaffordable.

Configuration control is also a difficult task because of CTAPS' development history. CTAPS was developed incrementally, and is still evolving. Recognizing both the importance and difficulty of controlling the CTAPS configuration, the Joint Chiefs of Staff J-6 chairs a configuration control board overseeing the CTAPS evolution to become part of the Theater Battle Management Core Systems, and ultimately to reside within the

Global Command and Control System. Indeed, such configuration changes offer the benefit of continually expanding capabilities; however, keeping all the users operating the most recent CTAPS configuration is destined to remain a challenge.

Summary

Clearly, CTAPS is a powerful capability compared to unintegrated computer tools, not to mention paper charts and grease pencils. However, the CTAPS architecture suffers from three serious drawbacks in the areas of survivability, deployability, and supportability. In addition, the current CTAPS configuration also has five ancillary deficiencies in the areas of database standardization, support for the JFACC afloat, transition between JFACCs afloat and ashore, operator proficiency, and configuration control. Thus, conceptualizing how to better plan and execute air campaigns is a worthwhile endeavor. The next chapter describes a conceptual Reachback system, an answer to CTAPS architecture deficiencies.

Notes

[1] Lt Col Stephen J. McNamara, *Air Power's Gordian Knot—Centralized versus Organic Control,* (Maxwell AFB, Ala.: Air University Press, August 1994), 7-19.
[2] Ibid., 21.
[3] Lt Col Thomas R. Gorman, interviewed by author 7-10, 22 January 1997.
[4] Ibid.
[5] Col Carl H. Steiling, Theater Battle Management Core Systems Program Manager, Electronic Systems Center, Hanscom AFB, Mass., telephone interview with author, 19 November 1996.
[6] Joint Publication 3-56.1, *Command and Control for Joint Air Operations,* 14 November 1994, IV-4, IV-5.
[7] Ibid., IV-6 to IV-11.
[8] Gorman message.
[9] USAF Air Ground Operations School (AGOS), *FY97 Multimedia CD-ROM*, December 1996.

Notes

[10] Dr. Charles A. Fowler, *The Standoff Observation of Enemy Ground Forces From Project Peek to Joint STARS: A Prolusion* (pre-publication draft, undated) 17.

[11] Murray, 252-3.

[12] Lt Gen (Ret) Stephen B. Croker, mentor for Class 97-01, USAF Air Ground Operations School's Joint Air Operations Senior Staff Course, Hurlburt Field, Fla., comments made during class discussions, 7-10 January 1997.

[13] Col Carl H. Steiling, Theater Battle Management Core Systems Program Manager, to author, electronic message, subject: AWC Research, 24 February 1997.

[14] Notes, Class 97-01, Joint Air Operations Senior Staff Course (JSSC), USAF Air Ground Operations School, Hurlburt Field, Fla., 7-10 January 1997.

[15] Gorman message.

[16] AGOS CD-ROM.

[17] Gorman interview.

[18] AGOS CD-ROM.

[19] Gorman message.

[20] Gorman interview.

[21] AGOS CD-ROM.

[22] Gorman interview.

[23] AGOS CD-ROM.

[24] Gorman message.

[25] Gorman interview.

[26] AGOS CD-ROM.

[27] JSSC notes.

[28] Gorman message.

[29] AGOS CD-ROM.

[30] Gorman interview.

[31] Carl DeFranco, Rome Laboratory, Rome, NY, telephone interview with author, 22 October 1996. In addition to the shortcoming stated in the text, another problem is that CTAPS is tied to a lengthy air tasking cycle. The DARPA program "JFACC After Next" is exploring the feasibility of real-time, continuous ATO generation, as well as designing a geographically distributed data processing version of CTAPS in conjunction with Rome Laboratory, Air Combat Command, and other organizations.

[32] Croker, class comments.

[33] Horner.

[34] Air Force Scientific Advisory Board, *Vision of Aerospace Command and Control for the 21st Century,* SAB-TR-96-02ES, 26 November 1996, on line, Internet, 23 January 1997, available from http://web.fie.com/htdoc/fed/afr/sab/any/text/any/sabvis.htm, 5.

[35] JSSC notes.

[36] Thomas A. Keaney and Eliot A. Cohen, *Gulf War Air Power Survey Summary Report,* (Washington, DC: Government Printing Office, 1993), 4.

[37] Col William Hoge, CENTAF AOC Director, Shaw AFB, NC, comments made during class discussions at the Joint Air Operations Senior Staff Course, 7-10 January 1997.

Notes

[38] General Charles A. Horner, "What We Should Have Learned in Desert Storm, but Didn't," *Air Force Magazine* 79, No. 12 (December 1996): 52-55.

[39] Air Force Scientific Advisory Board, 2.

[40] Chairman of the Joint Chiefs of Staff, *National Military Strategy of the United States of America,* 1995, 7.

[41] *Joint Vision 2010*, 4.

[42] Maj Gen (Retired) John A. Leide, USCENTCOM J-2, Briefing given to the senior officers at Electronic Systems Center, Hanscom AFB, Mass., 12 June 1996.

[43] Defense Advanced Research Projects Agency, *JFACC Concept: Jump Start to Future,* JFACC After Next Program Review, 14 August 1996, 61.

[44] JSSC notes.

[45] Croker, class comments.

[46] Joint Publication 3-56.1, 8-9.

[47] Cdr. D. W. McSwain, Naval Ocean Systems Center, San Diego, Calif., lecture presented at the Joint Air Operations Senior Staff Course, 7-10 January 1997.

[48] JSSC notes.

[49] Croker, class comments.

[50] JSSC class discussion.

[51] Ibid.

[52] Gorman interview.

Chapter 3

A Conceptual Reachback System

Man. . .walks up the stairs of his concepts, [and] emerges ahead of his accomplishments.

—John Steinbeck

Automating the JAOC with CTAPS was a real breakthrough, and the Reachback operations concept further leverages the advantages afforded by widespread automation in the JAOC. However, before the relative merits of a Reachback system versus the current CTAPS architecture can be discussed, the Reachback system must be defined. This chapter takes on that task at a level of detail sufficient to set the stage for discussing a Reachback system's advantages and drawbacks in Chapters 4 and 5, respectively.

For the purposes of this paper, *Reachback operations* refers to using data-linked, but geographically separated, segments of an air campaign planning and execution system to enhance the survivability, deployability, and supportability of that system. A *Reachback system* is a conceptual collection of communications equipment, computer hardware, and software necessary to conduct Reachback operations. The *deployed segment* of a Reachback system consists of the equipment located in the theater, specifically in the JAOC, while the *garrisoned segment* (also referred to as the *garrison*) contains all of the Reachback system's equipment not required to be deployed. The garrisoned segment would be located away from the theater's immediate dangers. Except where otherwise

noted, this paper envisions the garrisoned segment as being located in the CONUS. Although the JAOC is located in the theater, the staffs of both the deployed and garrisoned segments are collectively referred to as the *JAOC staff,* for they are in reality one team. The CTAPS components discussed in Chapter 2 could comprise a near-term Reachback system if appropriately data-linked and partitioned between the deployed and garrisoned segments. However, this paper does not limit the definition of a Reachback system to only new CTAPS architectures. Other implementations are possible using communications, computer hardware, and software still in development. With these definitions and clarifications in mind, this chapter next discusses in more detail the attributes of a Reachback system.

The first order of business when conceptualizing a system is to decide on the design goals. Broadly speaking, a Reachback system must provide the same or better tools as CTAPS now does to everyone on the JAOC staff, giving them the same ability to prosecute the air campaign, while minimizing the number of personnel and the amount of equipment in the theater. A Reachback system concept should also address all three of the CTAPS architecture deficiencies noted in Chapter 2, improving upon each of these deficiencies to the extent possible with current or imminent technology. Finally, a Reachback system must use high capacity, reliable, secure, and survivable communication links to tie its deployed and garrisoned segments together into a "virtual JAOC."

The Reachback system concept is central to accomplishing the above design goals. The US Central Command's JAOC Director recently observed, "If an operator spends the whole day at a computer terminal in the JAOC, what does it matter where the room

containing the terminal is? Why not keep that room back in the CONUS?"[1] Conceptually, a Reachback system design is no more complicated than deciding which functions to retain in a CONUS (or other rear area) garrison; however, to actually make the system work, state-of-the-art distributed data processing and communication technologies are required.

Three fundamental questions arise immediately when considering Reachback systems: First, what is the appropriate separation of personnel and functions between the garrisoned and deployed segments? Second, where should the garrison be located? And finally, how will all the geographically separated components communicate? The remainder of this chapter addresses these three questions in the context of a major regional contingency scenario, similar to Desert Storm. If a contingency has a significantly different character than Desert Storm, such as the recent intervention in Haiti,[2] then the JFC's concept of operations may require changes to the way the JFACC operates, and hence, changes to the JAOC configuration as well.

Separation of Personnel and Functions

A Reachback system must support both the JFACC and the JAOC staff. Thus, deciding how to segment the CTAPS architecture should start with understanding the JAOC organization. Based on that understanding, a recommendation is possible regarding where the JFACC, the JAOC staff, and any international coalition officers should be located. Finally, the workstations associated with the JAOC staff can be distributed between the garrison and the theater.

Joint Air Operation Center Organization

Figure 3 illustrates a notional JAOC organization. Actually, JAOC manning can be divided into four groups. The first is the command section and the JFACC's staff personnel.
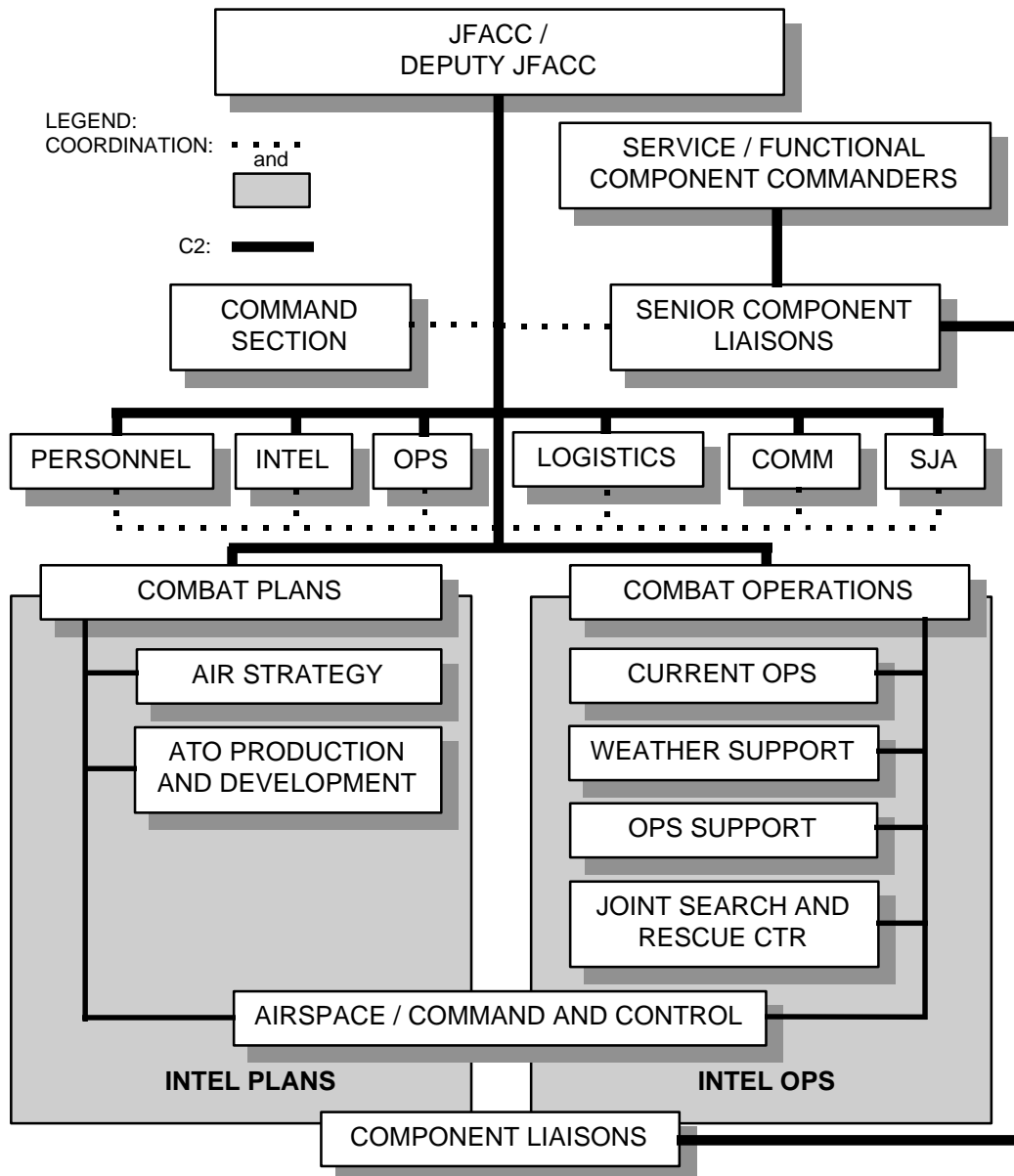
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                        │    JFACC /       │
                        │  DEPUTY JFACC    │
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  LEGEND:                         ┌──────────────────────────┐
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  ┌────────────────────┐        ┌────────────────────────┐
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      │ATO PRODUCTION│              │ WEATHER SUPPORT  │
      │AND DEVELOPMENT│             └──────────────────┘
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        INTEL PLANS                  INTEL OPS
              ┌───────────────────────┐
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Source: Joint Publication 3-56.1 *Command and Control for Joint Air Operations,* (14 November 1994), II-6.

Figure3. Notional Joint Air Operations Center Organization

This group performs typical administrative duties. The second group is combat plans. This organization, as the name implies, looks ahead, anticipating the needs of the JFC both in the near and long terms. In addition to supporting the ATOs in work, combat planners also generate sequels, or plans for the upcoming phase(s) of the JFC's campaign. Based on the most recent combat assessment and the JFC's guidance, combat plans develops the MAAP, and ultimately the ATO. The third group, combat operations, is responsible for overseeing ATO execution. In the words of General Croker, "Combat ops gives us the quick reaction capability we need to fight a war flexibly."[3] The fourth group consists of the liaison officers from land, maritime, space, and special operations component commanders.[4] Liaison officers do not actually work for the JFACC, but they do represent their commanders' interests and campaign goals to the JFACC, and provide feedback to their commanders regarding air operations.

JFACC Location: Arguments for JFACC in CONUS

When considering where each member of the JAOC should go, the first, and by far the most important question must be "Where is the JFACC?" One school of thought (not shared by this author) argues for locating the JFACC in the CONUS.[5] Briefly, the arguments for a CONUS-based JFACC are that (1) the JFACC will have better information in the CONUS and so can do a better job there, (2) forward deployed headquarters are vulnerable, difficult to deploy, slow to set up, and have poor connectivity, and (3) many flying units under the JFACC's control will not be based in the theater anyway, so little would be gained by exposing the JFACC to enemy action. In reality, these arguments have serious flaws for most contingency situations.

JFACC Location: Arguments for JFACC in Theater

For clarity, the counterarguments for the JFACC serving in the theater rather than the CONUS are presented in the same order as listed above. The first point deals with information availability. As discussed in more detail later in this chapter, communication and information technologies will increasingly make available any information needed by anyone located anywhere. In fact, the theater, not the CONUS, is the source of much of the information germane to the JFACC (mission status, logistics data, human intelligence, and so forth). In the highly unlikely event that communications between the theater and the CONUS were interrupted for any reason, the JFACC would actually be better off in the theater rather than in the CONUS, not only because the data originating in the theater would still be available, but also because the JFACC's communications with the in-theater air forces should still be possible through a variety of channels.

The second argument explores the disadvantages of a forward deployed headquarters. This paper shares those concerns; indeed, they originally motivated this study. However, a forward deployed headquarters also has overriding advantages. In the future, the United States will likely fight major regional contingencies as part of multinational coalitions,[6] so the deployed headquarters is not only where the JFC will be found, but also where the military commanders and staffs of the other coalition nations will be located. Personal interactions with all of these commanders, as well as the other US component commanders in the theater, are absolutely necessary if the JFACC is to support them well.[7]

The third argument for a CONUS-based JFACC pertains to basing a significant, perhaps predominant portion of US air assets in the CONUS, or at least far from the

theater. While it is true that a few assets like intercontinental bombers may sortie from the United States to fight a major regional contingency, in the foreseeable future, the vast majority of air combat assets must be based in, or at least close to the theater, as they were during Desert Storm. Otherwise, they will have neither realistic combat ranges, nor short enough mission duration's to allow a useful number of sorties per day. Even if future aircraft designs have enough range, and can fly fast enough that the crews will still be fit for combat after a marathon flight, the bulk of tactical aircraft will probably be the same ones the United States fields today. Advanced technology aircraft like the F-22 are too expensive to procure more than a few hundred, certainly not nearly the number of aircraft used in the Gulf.[8] For many years, perhaps even decades to come, most of the JFACC's forces will be based in the theater. As the next paragraph explains, if the forces are in the theater, that is where the JFACC should be.

Besides planning and executing the air war for the JFC, the JFACC has equally important responsibilities to the airmen (officers as well as enlisted) in the theater. The last "C" in JFACC stands for *commander,* the most duty-bound position in the military. In short, the JFACC must lead people. To do so means the JFACC must stay in touch with the airmen, eat in their mess tents, shake their hands, and thank them for their sacrifices. No video teleconference can ever do these things. Perhaps someday a JFACC will be killed while serving in a combat zone; so be it. But as long as the last "C" means commander, the theater is where the JFACC belongs.

JAOC Staff Location

Given that the JFACC will be in the theater, the recommended duty locations of other JAOC members can be addressed, given a Reachback capability. Clearly, the

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JFACC's senior deputies and advisors need to be in the theater to help the JFACC coordinate with other command elements, as well as to serve as the JFACC's "brain trust." On the other hand, a large majority of the command section and JFACC's administrative staff can operate in garrison. Their jobs can be easily handled through a Reachback capability. Combat plans also has a number of personnel who can work effectively in garrison. These are the vast majority of the targeteers, weaponeers and ATO production specialists. However, the combat operations staff has a smaller percentage of personnel who can work from a garrison. Often, they act as troubleshooters and expediters, constantly on the telephones to the flying units, talking to the liaison officers, or consulting with senior JAOC staff about real-time changes to the ATO. In fact, some JFACCs detail many of these personnel from the operational wings for two to three week increments, not only so they can better communicate with their counterparts at the air bases, but also to help the JFACC and the JAOC staff stay in touch with the real war.[9] Like combat operations, the liaison officers need to be in the theater. They are the bridges between the JAOC and the supported commanders on the ground or at sea. They must interact extensively with the JFACC and the senior JAOC staff, as well as maintain close communications with the commanders they represent.

The actual number of personnel who can be left in garrison depends on the specific configuration of the Reachback system, as well as the JFC's concept of operations, and the JFACC's decision on how to best support the JFC. However, based on experience, both General Croker and the US Central Command's JAOC Director estimate that as many as 800 of the 900 total personnel of a typical JAOC could probably operate from the CONUS with the help of a Reachback system.[10] The remaining 100 are the JFACC's

senior staff, combat operations monitors and expediters, and liaison officers. This figure represents almost a 90 percent reduction in deployed personnel. Perhaps having 800 fewer people in the theater's headquarters sounds like a trivial reduction compared to the size of an Army corps, but as Chapter 4 explores in more depth, the advantages of these particular 800 people being in a CONUS garrison are considerable.

Due to the garrison's protected location, the 800 personnel stationed in garrison need not all be military personnel. Clearly, the garrison commander should not only be a military officer, but should also be an experienced senior JAOC staff member enjoying the JFACC's absolute trust.[11] However, many of the workstation operators could be civil servants, preferably with extensive prior military experience in the same or similar JAOC duties. Chapter 4 examines the benefits of using civil servants in these positions.

Coalition Involvement

As mentioned above, in all likelihood most of the United States' future conflicts will include a coalition of allies, not just US forces. During Desert Storm, other Coalition partners relied on US command, control, and intelligence capabilities, since these countries had not made similar investments for their own forces.[12] Although some countries such as France and Australia are now making these investments,[13] for the foreseeable future, coalition air campaigns will probably require US automated capabilities. Lacking their own versions of the JAOC, allied air force officers will probably serve alongside US personnel, as is now the case in the Korean and Bosnian theaters. The Reachback concept does not preclude such multinational involvement; in fact, allied military officers would add significant value to operations at both the deployed and garrisoned segments of a Reachback system. If the JAOC is directing allied air force

sorties, liaison officers from the participating countries would be of great value not only in communicating with their commands, but also in mission planning for their country's air forces. To prepare for future contingencies, allied air force officers should constitute part of the JAOC staff during multinational exercises, serving both in the theater and in the garrison. They should participate in all JAOC functions, limited only by security constraints on some intelligence data. In the future, these security restrictions will probably decrease. The United States is developing computer operating systems allowing multilevel security, in other words the ability to allow users with lower security clearances to operate workstations containing data at a higher security level. For example, with multilevel security, an allied officer could operate a Reachback system workstation even if some data in the system were restricted to only US personnel. In addition, since Desert Storm, US restrictions have loosened considerably for foreign releasability of many types of intelligence information, so involving allied officers in virtually all JAOC activities should be straightforward.

Reachback System Hardware Location

A 90 percent reduction in manning would not necessarily correspond to a 90 percent reduction in the JAOC's footprint, since not all of the JAOC staff use the same amount of computer hardware and supporting infrastructure. This section examines equipment placement based on where the various types of manpower are stationed. In effect, the following estimate combines the above discussion on the location of people with the relationship between functions and equipment, as discussed in Chapter 2 and shown in Figure 2.

At this point, a few words of caution are in order. The following hardware placement estimate assumes a Reachback system would have the same functions, and be divided into roughly the same types of automated tools, as CTAPS is now. There is no reason this must be so. Although the CTAPS functions described in Chapter 2 would still be necessary, the system's components need not remain the same. In other words, a different set of computer tools may do the same job as CTAPS, but divide the tasks differently. For example, Rome Laboratory's design for the next generation Distributed Air Operations Center has three primary tools: APS, RAAP, and a new tool called FLEX (Force Level Execution).[14] Another implicit, and probably somewhat unjustified, assumption is that CTAPS efficiency would not be degraded by geographically separating the deployed and garrisoned segments. Chapter 5 explores in more depth the rationale for expecting some inefficiencies in operating a Reachback version of CTAPS, and discusses the expected equipment and manpower growth to compensate for these inefficiencies. Therefore, the following discussion merely illustrates the possible numbers and types of workstations at the deployed and garrisoned segments, rather than purporting to determine an exact equipment count at each location.

Figure 4 illustrates a Reachback system's potential to retain equipment in garrison. In this figure, each rectangle represents a CTAPS tool. The boxes in the left hemisphere represent tools located in a garrison, while the boxes in the right hemisphere denote tools deployed in the theater. The number in each box shows how many computer workstations may be associated with that tool. Dashed lines connecting rectangles represent distributed data processing operations between the garrison and the theater. For

clarity, this figure shows neither the local nor the wide area networks tying all these tools together,
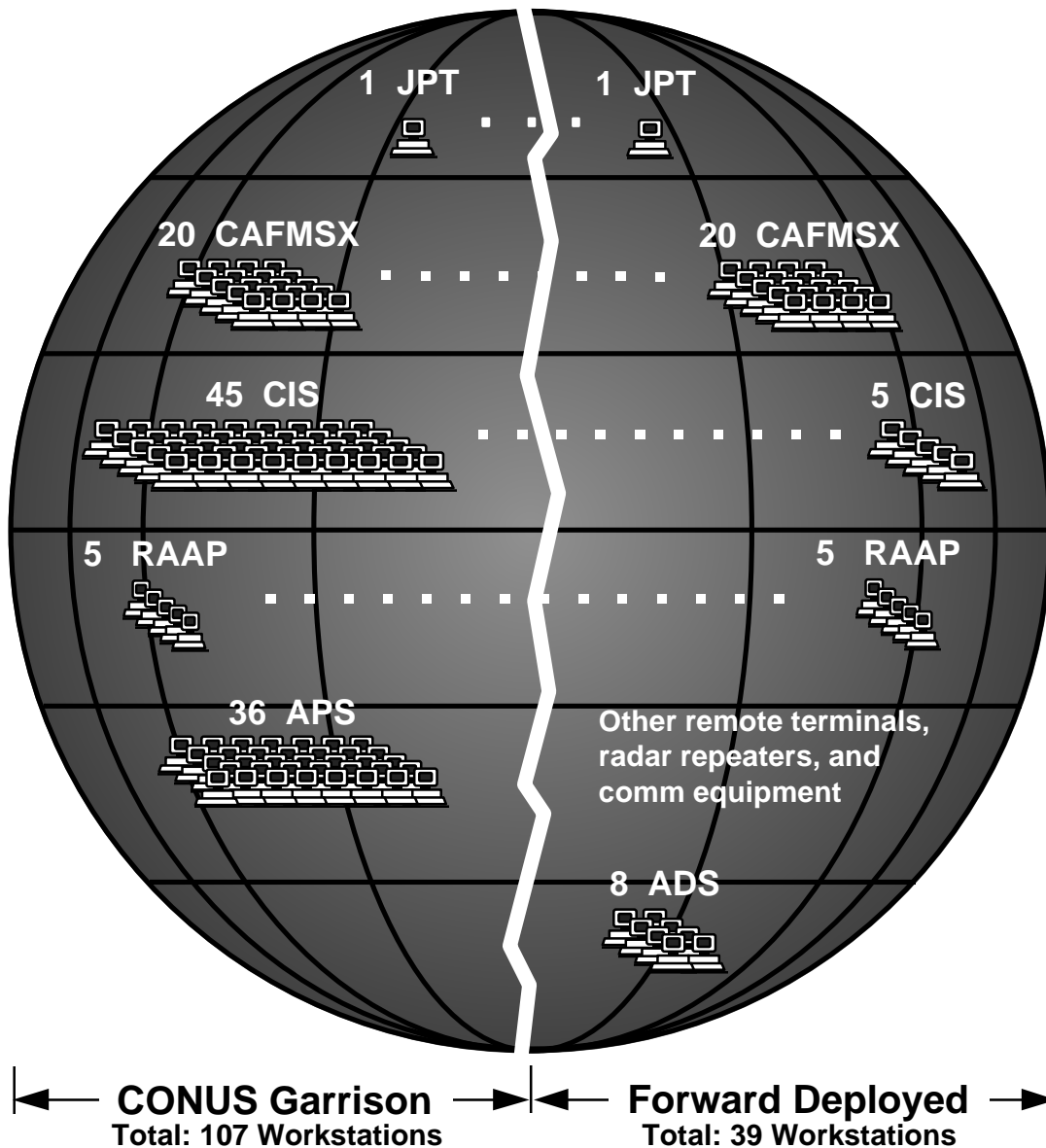

Figure4. Workstation Distribution for a Conceptual Reachback System

but of course they are also necessary. Together, the garrison and theater have 146 workstations in this notional configuration. The total of 39 workstations slated for

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deployment is reasonably consistent with the deployed manning estimate of about 100 personnel.

Further explanation is necessary regarding the hardware block first making its appearance in Figure 4: the block labeled "other remote terminals, radar repeaters, and comm equipment." The types and quantities of these electronic components vary considerably with the nature of the contingency, available facilities, and the extent of the duties the JFC delegates to the JFACC. If the JAOC must manage a complex air defense environment and maintain data links with numerous legacy systems (for example, to coordinate with other joint force components or coalition commands), this hardware block may represent a very large amount of support equipment, perhaps as much as the equivalent of 80 workstations.[15] Depending on how much of this additional hardware is necessary, a Reachback system could reduce the equipment in the theater by roughly 50 to 70 percent.[16]

Of course, the deployed segment of a Reachback system will use other equipment as well. The JAOC will need everything from desks and chairs to stable, filtered electrical power and environmental control. None of these additional needs are included above, since the host country's infrastructure should be able to supply the JAOC as necessary, except under unusual circumstances. To the extent the host country cannot satisfy the JAOC's additional needs, airlift requirements will increase.

To recap, for a major regional contingency, Reachback operations could reduce in-theater JAOC personnel by about 90 percent, and decrease the deployed hardware by 50 to 70 percent, depending on how much additional support equipment the contingency requires.

Garrison Location

The second major question germane to a Reachback system concerns the location of the garrison. In some ways, choosing the garrison location is peripheral to this paper's thesis. The technology will work just as well wherever the garrison is. However, this is not an insignificant issue, for some of the advantages (or lack thereof) of Reachback operations hinge on where the garrison is based. In addition, the location decision is not transparent to programmatic issues, for some locations may require far less money than others to host a Reachback system.

For reasons discussed later, this paper expects the garrison (or two garrisons, as also discussed later) will be located in the CONUS. Of course, locations other than the CONUS are also conceivable, and in specific circumstances may even be desirable for a prepared theater. For example, warfighters and system developers are considering a garrison in Japan or on Guam to support the Korean theater with a form of Reachback operations.[17] Nevertheless, for more diversified applicability to contingencies worldwide, particularly in unprepared theaters, a CONUS location is preferable for reasons Chapter 4 explores.

U-2 Reachback Example

A historical analogy will illuminate the importance of the location issue. In the 1980s, the U-2 aircraft program developed a Reachback capability for remote ground station processing of data collected in-flight. However, rather than using this Reachback capability, the U-2 would typically downlink data to an in-theater ground station for processing, analysis, and dissemination. This was the way U-2s conducted operations in

Europe until the end of the Cold War, during Desert Storm, and still today in South Korea. The theater commanders-in-chief (CINCs) felt strongly about the ground station location, for they knew they could depend on assets in their theaters, while assets outside their theaters were also outside their control. However, when U-2 support for Bosnia became necessary, the last available ground station was at Beale AFB, California. Moving the ground station to Europe would have made it unavailable for training and for other contingencies. Instead, the Air Force established a datalink between the U-2s supporting Bosnia and the ground station in California. There, the data are processed, and the results are sent back to the Combined Air Operations Center in Italy, with only a few seconds added to the data processing timeline. This arrangement works well, the European Theater is supported adequately, and the ground station can still conduct training in California, as well as world-wide U-2 operations.[18] The eventual acceptance of the U-2 Reachback capability may be a good model for JAOC Reachback systems.

Possible Basing

Perhaps for the same reason that the theater CINCs did not want to lose control over their U-2 ground stations, senior Air Force officials have been reluctant in the recent past to endorse Reachback operations for the JAOC.[19] One way to mitigate this concern is to locate Reachback garrisons at the home bases of all the numbered air forces and the rest of the 28 DOD units potentially involved in conducting air campaigns. The commanders could more easily oversee JAOC training, orchestrate exercises, refine their concepts of operations, and become more familiar with Reachback operations overall. Of course, if pursued for all or even most of these 28 units, this course of action would entail much equipment duplication.

Recommended Basing

In the long run, a phased approach to locating the garrisons may be more advantageous. During the first phase, a single Reachback garrison would be established temporarily at a numbered air force headquarters. Initial training and operations would smooth the inevitable rough spots in the concept of operations, equipment design, and interoperability with other systems, and would give the numbered air force commander time to develop confidence in Reachback operations.

After satisfying these objectives, the program would enter the second phase. A permanent location (not necessarily at the first phase's base) would host a facility containing the equivalent of several Reachback garrison sites. Each potential JFACC would command a Reachback operator detachment stationed at this facility.[20] These detachments would be responsible for providing the Reachback capability necessary to support their respective JFACCs during exercises and contingencies. The garrison facility would be sized to support the highest realistic number of concurrent contingencies, exercises, and training sessions. Of course, despite sizing the facility for the worst-case workload, occasionally resource requests from different JFACCs may conflict. In such cases, a priority rating determined by the Joint Chiefs of Staff J-3 would settle any conflicts. During a major regional contingency, the JFACC's operator detachment could be easily augmented with trained, experienced personnel from other detachments. If needed, additional workstations would also be readily at hand.

Finally, the third phase would construct a second garrison at a different location, then electronically link the two permanent garrisons for survivability considerations, as discussed in the next section. Overall, this three-phased approach provides a robust,

expandable, and survivable Reachback capability, while at the same time minimizing hardware duplication at multiple bases.

Factors for Choosing the Location

Three factors should bear on the decision regarding the Reachback garrisons' locations. First, the garrisons' physical security must be assured. As prime wartime targets, the garrisons' locations should help protect against terrorist or guerrilla attacks, as well as against conventional cruise missile or ballistic missile attacks by a peer competitor nation. (Of course, nuclear weapons may also threaten the garrisons, but if nuclear weapons start detonating on American soil, the JFACC's responsibilities may switch to the US Strategic Command.) These survivability considerations argue for military bases with hardened, possibly underground, facilities. Preferably, the two bases would be somewhere in America's heartland, as these are the most difficult locations for cruise or ballistic missiles to attack successfully.

A few more words explaining the rationale for the dual garrisons concept are needed. As the residents of Oklahoma City can attest, being in America's heartland does not guarantee physical security. Thus, survivability considerations make an alternate, geographically separated, but electronically linked garrison highly desirable, if not mandatory. Thus, even if a garrison were destroyed or otherwise rendered ineffective, the JFACC could continue fighting the war using the alternate garrison. Of course, constructing and operating two garrisons would cost roughly twice as much as a single garrison,[21] but that cost increase must be weighed against the need to protect America's ability to conduct devastatingly effective air campaigns. As an added benefit, during peacetime one garrison could be used primarily in conjunction with Blue Flag exercises at

Hurlburt Field, Florida, and the other could routinely support Red Flag exercises at Nellis AFB, Nevada. Clearly, the garrisons would be centers of gravity for US air combat capabilities, so extraordinary efforts to assure survivability should be made.

The second factor for the location decision is access to communication links. Even though adequate links could be installed virtually anywhere in the United States, overall installation costs would be reduced if worldwide connectivity already exists at the garrisons' locations.

Finally, a host of facility and personnel support questions need to be examined for each candidate location. Issues include: existence of suitable structures and utilities, base and community services for perhaps several thousand additional families, and so forth.

Where to Avoid

Conducting site surveys to find the best garrison locations is beyond the scope of this study. Based on the above factors, Offutt AFB, Nebraska and Falcon AFB, Colorado, come to mind as possibilities, although undoubtedly there are other good choices as well. However, one location that would cause much consternation for operational commanders would be the Pentagon, or for that matter, anywhere in the Washington area. For the Reachback concept to succeed, the JFACC must command the garrisoned detachment. Unfortunately, locating a garrison near Washington will undermine confidence in the JFACC's command authority.

Overall, the precise locations for the garrisons are not as important as instilling confidence that the facilities and personnel will be there when the JFACC needs them. The three-phased approach discussed above will add to the JFACC's confidence in Reachback operations.

Communications

The third, and last major question about Reachback operations concerns the connectivity between the theater and the CONUS garrisons. Obviously, a high capacity, reliable, secure, and survivable global communications capability is a necessary enabling technology for Reachback operations. Without connectivity, the JFACC cannot use the garrisoned segment of the Reachback system.

Fortunately, the requisite communications technology already exists. As Lt Gen John S. Fairchild, Air Force deputy chief of staff for command, control, communications and computer systems, observed in January 1996:

> The Air Force recently demonstrated a major advance in sending massive amounts of information to dispersed warfighters. Using commercial satellite broadcast capabilities, the Air Force transmitted audio, video, imagery and data at speeds approaching 23 million bits per second. This impressive capability, named the Global Broadcast Service, is part of the Air Force's thrust to use state-of-the-art commercially available digital systems to improve command and control of air, land, and sea forces. The Air Force is dedicated toward enhancing joint and coalition warfare by rapidly distributing information to deployed warfighters throughout the theater of operations at dramatic cost reductions. Critical information such as the air tasking order, imagery, weather and command and control updates can be transmitted to literally thousands of warfighters, using antennas as small as 18 inches in diameter, in a matter of seconds.[22]

The Global Broadcast Service is not yet operational, but according to the vice chief of staff of the Air Force, it will be available "around the turn of the century"[23] for warfighting applications. Nor is the Global Broadcast Service the only communications network. Depending on the required communications speed, other commercial and military communications systems could handle a portion of the data flow. Due to rapid advances in communication technologies, the best communication system architecture to

support Reachback operations will be a matter of choice among a number of possibilities, not a matter of capability.[24]

Summary

Based on a major regional contingency scenario, a functional division of today's JAOC estimates that almost 90 percent of its personnel, and between 50 and 70 percent of its equipment can remain in a CONUS garrison. For survivability reasons, two garrison locations are needed. Where these garrisons should be located is an open question; however, neither garrison should be near Washington. Wherever the garrisons' locations, adequate communications technologies will be operational by about the year 2000. Given this system concept, the next chapter discusses the relative advantages of a Reachback system compared to the current CTAPS architecture.

Notes

[1] Col William Hoge, CENTAF AOC Director, Shaw AFB, NC, interview with author, 9 January 1997.

[2] Croker interview.

[3] Ibid.

[4] Air Force liaison officers would also be appropriate if the JFACC and much of the JAOC staff are naval officers.

[5] Jeffery R. Barnett, *Future War: An Assessment of Aerospace Campaigns in 2010,* (Maxwell AFB, Ala.: Air University Press, January, 1996), 65.

[6] White House, *A National Security Strategy of Engagement and Enlargement,* (Washington, DC: Government Printing Office, February 1996), 14.

[7] Croker, class comments.

[8] Murray.

[9] Class discussion, JSSC.

[10] Ibid.

[11] Croker interview.

[12] Leide.

[13] Col Charles T. Fox, Combat Air Forces Chair at the Air War College, Maxwell AFB, Ala., interview with author, 14 March 1997.

Notes

[14] Carl DeFranco, *Distributed Air Operations Center,* Rome Laboratory fact sheet, August 1996.

[15] Gorman interview.

[16] More precisely, the reduction is between 47 percent and 73 percent; however, this paper's notional division of workstations is not accurate enough to quote estimates to the nearest percentage point. The lower bound was calculated assuming an 80 workstation equivalency for additional support equipment in the JAOC, and the upper bound assumed no additional support equipment would be needed.

[17] Steiling message.

[18] Ronald L. Thompson, Deputy Director, U-2 System Program Office, Robins AFB, Ga., interview with author, 8 March 1996.

[19] Steiling interview.

[20] This detachment would not include the JFACC's administrative staff. The support team would remain at its base, where it could better interact with other support agencies for the air component command. A relatively straightforward data and video teleconference link would tie the support personnel to the deployed JAOC.

[21] Even though the software must be developed only once, other cost drivers such as facility construction, equipment procurement, and operations and maintenance would realize little or no savings by building and operating two garrisons instead of just one.

[22] Lt Gen John S. Fairchild, "HORIZON - A Jointly Focused Vision Charting the Course for the 21st Century Air Force," *Armed Forces Journal International,* January 1996, n.p.; on-line, Internet, 24 January 1997, available from http://www.dtic.mil.

[23] Gen Thomas S. Moorman, Jr., "The Challenge of Space Beyond 2000," remarks to the 75th Royal Australian Air Force Anniversary Airpower Conference, Canberra, Australia, 14 June 1996, on-line, Internet, 3 December 1996, available from http:/www.dtic.mil.

[24] Air Force Scientific Advisory Board, 5.

Chapter 4

Advantages of Reachback Operations

It's them that take advantage that get advantage i' this world.

—George Eliot

Of necessity, the preceding chapter hinted at several advantages of a Reachback system compared to the current CTAPS architecture. This chapter will expand upon those observations. As a framework for presentation, the following sections parallel the topics Chapter 2 explored regarding the CTAPS architecture's drawbacks.

Primary Advantages

Chapter 2 portrayed three principal deficiencies of the current CTAPS architecture: survivability, deployability, and supportability. In contrast, a Reachback system would feature these three attributes as principal advantages. Together, they motivate developing a Reachback system.

Survivability

A modern JAOC's large physical and electronic footprints are extremely serious concerns. Cutting the in-theater manning by 90 percent and the amount of deployed equipment by 50 percent to 70 percent would certainly decrease the JAOC's footprint, and thus increase the deployed segment's survivability.

Another aspect of survivability is JAOC functional continuity. A CONUS garrison's operations would not be interrupted by in-theater threats. Garrison operations could continue even if deployed operations were interrupted by enemy attack, personnel and equipment decontamination, JAOC relocation, and so forth. Admittedly, some less severe threats exist in the United States as well. However, two geographically separated, electronically linked, inland garrison locations would reduce the risks posed by these threats. Ultimately, increased JAOC survivability directly correlates with increased air combat effectiveness.

Deployability

Because US military forces are increasingly becoming expeditionary forces, rapid deployability during a crisis is an important factor in America's ability to project power overseas.[1] If only 100 of the original 900 JAOC staff members still need to deploy, the personnel transportation requirements shrink from 3 widebody airliners to a fraction of one airliner. More significantly, the real savings in airlift comes from deploying less equipment, not less people. Assuming the amount of airlift required for equipment varies approximately as the number of workstations, retaining 107 workstations in garrison would save over 19 C-141 sorties.[2] The airlift sorties freed from deploying JAOC equipment would be available to transport other vital supplies to the theater.

Another measure of deployability is the time required to make a deployed capability operational. Not only would a Reachback system arrive in theater using less lift, but it would also be ready to start planning and executing the air campaign sooner, because the majority of the system and its operators would not have to relocate. In many contingency scenarios, the JFACC need not depart for the theater until the JAOC is operational, so the

JFACC and the garrison staff could be producing JIPTLs, MAAPs, and even ATOs while the deployed segment is enroute. In extreme circumstances requiring immediate air combat, the JFACC could start fighting the air war while still in the CONUS. Of course, with today's CTAPS architecture, the JFACC could also direct the air campaign from the CONUS if so ordered by the JFC (as was the case during the recent military intervention in Haiti).[3] However, a subsequent JAOC relocation to the theater would either require a significant break in operations while CTAPS is reassembled, or force JFACC responsibilities to be transferred to a backup JFACC, followed by another disruptive responsibility transfer back to the primary JFACC. Clearly, the Reachback system's superior deployability provides more seamless support for quick reaction contingencies, thus better fulfilling the DOD's vision of expeditionary warfare.

Supportability

Like deployability, supportability has two aspects, people and equipment. Although supporting an additional 800 people in the theater is not trivial, the resulting problems are usually manageable. After all, far more than 800 people would deploy to fight a major regional contingency. In contrast, supporting the JAOC equipment is a difficult undertaking.

Many regions of the world pose stringent challenges to electronic equipment, particularly equipment built to commercial standards rather than the more rugged military specifications. Although a Reachback system would use the same commercial quality electronics as does CTAPS, supportability would be better because roughly 107 workstations would remain in a CONUS garrison. The garrison could stock spares, use additional equipment from its extra capacity, have on-site maintenance contracts, or use

some combination of all these support options. Of course, maintaining the Reachback system's deployed segment still faces the challenges of a harsh environment; however, the amount of equipment deployed is far less, which decreases the supportability burden commensurately.

Ancillary Advantages

This section examines five ancillary advantages of Reachback systems. These advantages, while important, do not constitute sufficient reason by themselves to invest in a Reachback system. Nevertheless, these additional benefits merit further discussion.

Database Standardization

Databases are vital to modern warfare, particularly air warfare. They contain virtually every fact needed for planning and executing air campaigns. Ideally, various military databases would all agree. After all, there is only one world, so databases representing the world should likewise be congruent.[4] Although this currently is not the case, particularly between Air Force and Navy intelligence-oriented databases,[5] a Reachback system offers hope for the future.

A master database maintained by the CONUS garrisons could solve two common database problems: differences in facts, and differences in data structures. If two CONUS garrison locations exist, as Chapter 3 strongly recommends, these two sites must be linked electronically to constantly correlate their databases to maintain identical database configurations. (Of course, electronically linking the two sites also enables either garrison to back up the other to increase survivability.) The master database could become a single interface to the myriad of intelligence sources, focusing both data receipt

and retransmission for intelligence germane to the air war. In the past, limitations in database capacity forced specialization in contents; thus, the military services each kept track of their own information in different ways. Technology advances have removed data storage and manipulation capabilities as meaningful constraints, so having a single "world picture" is entirely feasible and certainly desirable. This worldwide database need not be contingency specific, since the need for partitioning data by theater of operations is disappearing as database capacity increases. Further, the frustrating problem of the Air Force and Navy not being able to readily exchange intelligence data due to database structural differences would also be solved, for a single master database would have no such incompatibilities.

A new development in software technology, called the "object oriented database," should make a master database easier to design, implement, use, and extend as new application requirements evolve. An object oriented database would allow new data structures, such as multi-media digital video, audio, text, and maps to be used and stored in the reachback system.[6] Much work remains to formulate the standards and structure for such an ambitious undertaking;[7] however, a single, overarching JAOC database would be a seminal improvement in air campaign information management.

Support for the JFACC Afloat

The Navy has significantly expanded command and control facilities for JFACCs afloat. Although having limited capabilities, the USS *LaSalle* pioneered in providing JFACC support facilities at sea. The Navy's next step was to build two command and control ships, the USS *Mount Whitney* and the USS *Blue Ridge*.[8] These ships can direct far more extensive air campaigns than can an aircraft carrier. An augmented JFACC staff

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on an aircraft carrier can control two aircraft carrier wings, an Air Force wing, and an Amphibious Ready Group,[9] for a total of roughly 400 sorties per day.[10] In contrast, a command and control ship can control up to three aircraft carrier wings, two Air Force wings, and two Amphibious Ready Groups,[11] totaling over 800 sorties per day.[12]

The Navy's command and control ships can be critically important resources when the JFACC cannot be ashore. Facilities aboard these ships can support a 280 person staff for the JFACC.[13] As a further improvement, the Navy is modifying the USS *Coronado* to become a "Joint Command and Control" ship capable of accommodating a 200+ person JFC staff, as well as a 240+ person JFACC staff.[14] Even though a larger staff cannot reside aboard ship, reachback operations can augment the JFACC afloat with a "virtual JAOC staff" as large as the air campaign requires.

A JFACC afloat would use the CONUS garrison's capability much like a land-based JFACC would. The concept of operations would be identical, except the JFACC afloat would want to tailor the capabilities in garrison to best complement the capabilities already resident aboard the command and control ship. Not only would the JFACC afloat enjoy extended staff support, the JFACC would also gain a powerful communications node due to the garrison's connectivity to deployed forces and intelligence sources, as well as many of the other reachback system advantages described in this chapter. If augmented by a reachback system, the Navy estimates a command and control ship could direct perhaps as many as 2,000 sorties per day, and surge as high as 3,500 sorties per day on a limited basis,[15] as opposed to today's capability of 800 sorties per day. Thus, a reachback system offers the possibility of increasing a sea-based JFACC's sustained daily

sorties by 250 percent. More importantly, with the aid of a reachback capability, a JFACC afloat could begin a potent air war as the prelude to land-based JAOC operations.

Transition between JFACCs Afloat and Ashore

Another advantage of reachback operations is the ability to make the transition between JFACCs afloat and ashore relatively seamless, and certainly more transparent to theater air forces. Instead of a Herculean effort to transfer voluminous, structurally incompatible databases, that transfer would not even be necessary if both the land and sea-based JFACCs used the same CONUS garrison's database. In addition, many of the skilled weaponeers, targeteers, and other operators in the garrison would continue to support the war with no need to physically transfer anywhere. Of course, the JFACC ashore might also want a number of key staff members afloat to join the land-based staff, both for continuity and liaison purposes; however, a widespread transfer of most staff members would not be necessary. If the situation warrants, a reachback system would also simplify the process of transferring from a JFACC ashore to a JFACC afloat, for the same reasons discussed above.

A question remains pertaining to communications capabilities between the command and control ships and the garrison. Today, these ships can call on seven types of communications links;[16] however, JFACCs still consider restricted communications to be a large problem when at sea.[17] To ensure connectivity between the JFACC afloat and the garrison, the Global Broadcast Service and other advanced communications capabilities must not overlook such an important user as the Navy's command and control ships.

Operator Proficiency

A JAOC staff is a team of skilled professionals using state-of-the-art tools to perform an enormously challenging mission. Senior JAOC officers agree that operator proficiency, not only for targeteers and weaponeers, but also for database managers and computer system administrators, is difficult to maintain. An experienced military database manager or system administrator can easily find a lucrative civilian job, causing high turnover rates in these career fields.[18]

The reachback concept offers a solution. Simply put, the CONUS garrison is an ideal place for the DOD to locate many of these lucrative jobs, hiring back former active duty personnel with JAOC experience. Instead of relying largely on short-term military personnel, garrison manning could be strengthened considerably by employing permanent, experienced, relatively high grade civil servants. Since the garrison would not deploy anywhere, civil service staff would be well suited to stay in these positions for many years, building up a tremendous experience base and providing much needed continuity to the JAOC staff.

Configuration Control

Nothing seems to change faster than electronics technology. The computer used to write this report is only two years old, but is outdated by at least one technology generation. Both processing speed and memory seem to double every 18 months. Software tends to remain usable longer, in part because most new compilers and operating systems allow backward compatibility for older software versions. However, software maintenance is a continual process, for complex applications are seldom error free. Even well written code often requires modifications when other interfacing

programs or hardware change. This turbulence throughout the electronics industry creates configuration control problems for a system as complex as a reachback system.

One solution to this conundrum is to colocate most of the computer equipment, and maintain configuration control for all equipment and software at the same time. This approach matches nicely with the reachback operations concept. The garrison's configuration could be controlled by a single maintenance contract. In addition, the same contract could maintain and upgrade the workstations slated for deployment. The DOD should name an executive agent (from a roles and missions perspective, probably the Air Force) to manage this contract. As is standard for joint activities managed by one service as the executive agent, other participating services would contribute their fair share of the maintenance budget for whatever workstations and related equipment they own. Hardware and software configurations could be controlled, equipment could be upgraded to the latest in performance, maintainability, and compatibility, and the funding to do all of this could be protected at a high level within each service, rather than being dispersed to subordinate units, where it is often reallocated for other pressing needs.

Summary

Overall, a reachback system offers compelling advantages. It would improve upon all of the CTAPS deficiencies discussed in Chapter 2, in some cases dramatically, through advanced communications and distributed data processing technologies. Incorporating these technologies would give the US military a boost in air campaign planning and execution. However, as is virtually inevitable with any good idea, it also has drawbacks. Chapter 5 addresses these disadvantages, and proposes mitigation possibilities.

Notes

[1] Air Force Scientific Advisory Board, 2.

[2] This result derives from the number of C-141 sorties required to fully deploy CTAPS with its current architecture. Today, 146 workstations, plus the equivalent of 80 workstations worth of additional remote terminals, radar repeaters, and communications equipment, requires 41 C-141 airlift sorties. Thus, assuming the number of sorties varies approximately as the number of workstations and the amount of support equipment, reducing the number of workstations by 107 would save 19.4 C-141 sorties to the theater.

[3] Croker interview.

[4] Air Force Scientific Advisory Board, 7, 12.

[5] JSSC notes.

[6] Gerald M. Friedman, Battle Management Portfolio Chief Architect, MITRE Corporation, Bedford Mass., telephone interview with author, 17 March 1997.

[7] Gorman message.

[8] Cdr D. W. McSwain, Naval Ocean Systems Center, USN, to author, electronic message, subject: Air War College Research Paper on Reachback Operations, 5 February 1997. In all, the Navy has four ships with varying capabilities to support a JFACC afloat. The USS *Mount Whitney* supports the 2nd Fleet in the Atlantic Ocean. USS *Blue Ridge* is assigned to the 7th Fleet in the Pacific Ocean. The Navy uses the USS *LaSalle* to support air operations in the Mediterranean Sea, and is modifying the USS *Coronado* to support the 3rd Fleet in the Pacific and Indian Oceans.

[9] AGOS CD-ROM.

[10] JSSC notes.

[11] AGOS CD-ROM.

[12] JSSC notes.

[13] McSwain comments.

[14] McSwain message.

[15] Ibid.

[16] AGOS CD-ROM. The seven classes of communications are: SHF SATCOM, EHF SATCOM, SINCGARS, INMARSAT, UHF SATCOM, UHF LOS, and Commercial SATCOM.

[17] Croker interview.

[18] JSSC class discussion.

Chapter 5

Drawbacks of Reachback Systems

There is nothing either good or bad, but thinking makes it so.

—Shakespeare

Some drawbacks of reachback systems are a matter of perception, others are consequences of real world limitations. This chapter explores reachback operations' negative aspects, both perceived and actual, and discusses ways to mitigate these undesirable qualities. Topics appear roughly in their order of severity.

Senior Officer Reservations

Military commanders are a cautious group, rightly so, given the possibly calamitous consequences of poor decisions.[1] Thus, doubts are certainly understandable over the wisdom of splitting the JAOC's resources, physically separating the two segments, then locating one of the segments back in the CONUS. In particular, senior officers might worry about a CONUS garrison reducing their operational autonomy.

For over two millennia, military commanders have resisted excessive direction from their capitals. In 168 BC, Lucius Aemilius Paulus, the consul in charge of the Macedonian campaign, addressed the citizens of Rome: "In all the clubs and even—God save us!—at dinner tables there are experts who lead armies to Macedonia. Such behavior

is a great obstacle to the men in the field .Generals should receive advice from those who are on the scene of action, who see the terrain, the enemy, the fitness of the occasion, who are sharers in the danger. . .Be aware that I shall be satisfied with the advice originating in camp."[2]

Today, like Lucius Aemilius Paulus, US commanders in the field view direction from Washington as counterproductive. In this respect, Desert Storm was no different than any other war. Following the public relations disaster of killing hundreds of civilians in the Al Firdos bunker, Gen Colin L. Powell prompted resentment within the Air Force because of his pressure to stop bombing Baghdad. At the time, he acted to maintain the US public's and Coalition partners' support for the war; nevertheless, "to the Air Force, it seemed as if the political fallout from the Al Firdos raid had accomplished what the Iraqi air defenses could not: downtown Baghdad was to be attacked sparingly, if at all."[3]

Perceived Loss of Control

The "principle that Washington should. . .leave the details up to the theater commander"[4] is sacrosanct to CINCs and JFCs. Admittedly, a reachback system's CONUS garrison poses at least the possibility of Washington directing the air war. A detailed discussion of the rationale for avoiding such involvement by Washington would constitute a separate treatise; suffice to say that America has long depended on experienced military commanders to use their initiative to react to unforeseen circumstances, and to capitalize on fleeting opportunities. Military leaders in the field "see the terrain, the enemy, [and] the fitness of the occasion," as no politician or, for that matter, no military officer can in Washington.

Further, the U-2 ground station basing decision illustrated the theater commander's unwillingness to depend on assets outside the theater, that presumably are not under the commander's control. Indeed, neither the CINCs nor the JFCs will ever have a guarantee that no other crisis will preempt their access to resources in the CONUS.

Mitigation

Although losing control of the reachback garrison's output is a possibility, it is by no means preordained. For the most part, this concern motivated Chapter 3's recommendation that a detachment commanded by the JFACC operate the garrison. If required, wartime augmentation could come from detachments belonging to other JFACCs; however, the garrison's core support would come from personnel commanded by the JFACC fighting the air war.

Likewise, in part this issue also influenced the conclusion that neither of the two garrisons should be near Washington. (The other motivation was physical security. Washington's coastal location provides less warning time of cruise or ballistic missile attacks than do locations in the US heartland.) If the CONUS garrisons reside far from Washington, their locations should lessen the opportunities for unsolicited direction.

Admittedly, actions speak louder than words. CINCs, JFCs, and JFACCs will believe reachback systems need not encourage unwelcome "help" from home only after they live through several exercises, and perhaps even a major regional contingency or two, with little coaching from Washington.

Dependence on Communications

The first reaction many warfighters expressed when introduced to the reachback operations concept was "you'd better have good comm. links!"[5] Indeed, not only do reachback operations depend on robust, reliable communications, so also does virtually every other facet of modern warfare. Of course, absolute guarantees do not exist when considering communications.

Vulnerability to Communications Outages

Theoretically, communications links have many Achilles' heels. Natural phenomena such as sunspots and lightning can disrupt communications. Enemy action, particularly by a peer competitor nation, can also degrade or deny US connectivity to the theater. A variety of means exist, from the most selective jamming technique to the most indiscriminate electromagnetic pulse from a nuclear detonation, to deny the ability to communicate. Not only are the links potentially vulnerable, but the ground stations and even the data being transmitted are also subject to attack. While completely enumerating all electromagnetic communication vulnerabilities is beyond the scope of this paper, an important concept is that "good comm. links" cannot be absolutely guaranteed.

A related concern is the available bandwidth, in other words the range of frequencies comprising the broadcast signal. The larger the bandwidth, the greater the communication channel's maximum data transmission speed. Recent technology developments have vastly increased bandwidth over that available during the Gulf War. As General Fairchild observed in 1996, the Air Force recently demonstrated data transmission speeds approaching 23 million bits per second.[6] Today, the local area

network tying all the CTAPS tools together uses a data transmission speed of only 10 million bits per second,[7] so current communications technology should handle a reachback system's data rates. However, if history is a guide, whenever a communications channel has extra capacity, additional data are usually inserted in the broadcast until the channel is saturated.

Mitigation

Just as a complete discussion of communications vulnerabilities is beyond this paper's intent, so also is a treatise on how to protect against all the things that can go wrong. Fortunately, the US communications infrastructure can call upon a number of features to reduce communications vulnerabilities. Distributed and redundant links, jam-resistant frequencies, spread-spectrum signal hiding, automated frequency hopping, error-correcting data encoding, encryption, ground station security, and many other techniques can all be used to ensure connectivity as far as humanly possible.[8] In addition, new technologies such as the Global Broadcast Service will continue to enhance the robustness of communications between the CONUS and the theater.

If, despite the engineers' best efforts, connectivity between the CONUS and the theater were lost, the deployed segment would still have impressive computational power available to continue operations, albeit with greater difficulty. Figure 4 illustrates that even with 107 workstations remaining in garrison, 39 workstations for campaign planning, intelligence, airspace deconfliction, and real-time execution monitoring would still reside in the deployed JAOC. During a communications outage, some of these computers could run the other software tools as well, since any CTAPS workstation can run any CTAPS tool. This redundant capability would require periodically transmitting at

least a subset of the garrison's master database to the theater, but in return, the system would have a fallback operating mode to protect against communications failures.

In the near term, current bandwidth capabilities are sufficient to meet today's requirements. Both warfighters and system developers must exercise discipline to keep bandwidth requirements in balance with capabilities, so that "better" is not allowed to conquer "good enough." Over the long term, even though technology advances will undoubtedly increase usable bandwidth, a balance must be maintained. Thus, requirements for bandwidth-intensive signals, such as for numerous, simultaneous video teleconferences, must remain within the limits of available technology.

Although nothing could absolutely guarantee uninterrupted connectivity between a CONUS garrison and the JAOC, sufficient safeguards, robustness, and if necessary, fallback capabilities exist to protect this particular Achilles' heel quite well.

Decreased Operational Efficiency

Although survivability, deployability, and supportability would be enhanced, geographically separating CTAPS into two segments would not improve its operation. Instead, more effort would be required to maintain the same output that the two segments would have produced, had they remained colocated. This loss of efficiency must be acknowledged as a drawback to reachback operations.

Additional Equipment and Manning

Clearly, implementing a reachback system would require additional communications and interface equipment to electronically tie together the garrison and the deployed segment. The extent of this equipment depends in large part on the specific system

implementation. Nevertheless, the types of additional equipment can be estimated. The most demanding new requirements would be for data gateways linking the two groups of workstations into an electronically contiguous net. Another growth area would be for greatly increased video teleconference equipment, not only to connect the JFACC with the garrison, but also to link workstation operators together to substitute for face-to-face interactions. Additional equipment requirements would also derive from new electronic interfaces among the garrison and various intelligence organizations, as well as the new master database. Finally, extensive electronic interfaces connecting the two garrison locations would add to the new equipment list.

Total JAOC manning would also be greater than if the JAOC were undivided. Both the deployed and garrisoned segments would need extra liaison officers to coordinate operations between the two locations. Further, the garrison would require more staff than just the operator detachments and system maintainers. The garrison would also require a management staff to ensure the operator detachments receive all the support they need, to manage facility maintenance, and to implement the Joint Chiefs of Staff J-3's priorities to deconflict competing support requests in the event of simultaneous contingencies, or more commonly, simultaneous exercises.[9] Compared to today's JAOC, total manpower would probably grow by 10 percent to 20 percent or more, depending on the operations concept.[10]

Mitigation

To a large extent, centralization of facilities may offset the additional equipment requirements. Instead of 28 military commands all trying to equip themselves with some version of a JAOC, two garrisons could eliminate unnecessary duplication. Regarding

manning, the additional manpower billets would probably not see the same economies from centralization, at least in the near term. Of course, future technology developments beyond CTAPS may incorporate artificial intelligence or similar software capabilities to decrease manning requirements, but for now, the drawback of increased manning has no significant potential for mitigation.

JFACC Leadership for Garrisoned Personnel

Chapter 3 argues in the strongest terms that the JFACC is a commander, and as such, must interact personally with the airmen. If, as Chapter 3 also recommends, the JFACC commands the personnel in the CONUS garrison, leadership issues for these people may arise.

Challenges for Remote Leadership

Clearly, the JFACC would have little, if any, face-to-face interaction with the garrison's staff during hostilities. Both the JFC and the airmen in theater would have a greater need for the JFACC's presence. Further, because the garrison's staff would be far away from personal danger, the extra intensity and clarity of purpose gained from serving in a war zone may be absent.

A related challenge stems from the US military's cultural preference for combat assignments. Military personnel assigned to a garrison might feel stuck in a backwater job while their luckier contemporaries are gaining combat experience and enhancing their careers. For this reason, highly qualified warfighters might shun a garrison assignment. For military staff members ending up in a garrison, low morale may lead to sub-optimum performance.

Mitigation

Fortunately, if senior military officers are specialists in anything, it is leadership. The JFACC and subordinate commanders could avoid, or at least minimize, the problems discussed above through extensive personal contact with the garrisoned detachment before a crisis occurs. During a deployment, the JFACC would also have technology such as video teleconferencing available to communicate clearly with the garrison, and provide at least some of the personal interaction necessary to motivate extraordinary performance from the staff. Historically, CONUS-based personnel have given their maximum efforts to support a war. The administrative assistance given to General Horner from Tactical Air Command's headquarters during Desert Storm is but one recent example of CONUS support.[11] Thus, the garrison's commitment and productivity should not cause problems if the JFACC practices active leadership and establishes clear command relationships.

The JFACC must also address military members' perceptions that the garrison is a backwater assignment, not only by assuring the garrison staff of their critical importance, but also by ensuring personnel performance ratings are not unfairly biased in favor of the deployed staff. In addition, the DOD should view duty in a reachback garrison as an important joint tour for a warfighter's professional development. By emphasizing the garrison as a key component of America's warfighting capability, the JFACC and other senior officers could preclude morale and performance problems due to the garrison's protected location.

Theater Produced Intelligence

The Gulf War proved that not all intelligence comes from satellites, nor is all information heard first in the Pentagon. On the contrary, much useful, even critical, intelligence is produced in the theater. Sources include: pilot reports, gun camera film, infrared imagery, and synthetic aperture radar data, as well as the more traditional photography and electronic intercepts from intelligence, surveillance, and reconnaissance platforms. In recent years, intelligence from human sources, including prisoner of war interrogations and in-theater agents, has returned to its previous position of importance. This shift reflects a major change from a decade ago, when America relied almost exclusively on technical intelligence systems.[12]

Difficulty of Incorporating Theater-Produced Intelligence

Obviously, this wealth of theater-produced intelligence must somehow be injected into the CONUS garrison, particularly if the garrison is maintaining the master database. Not only do the garrison's intelligence analysts need this information, but the targeteers and weaponeers also use such reports daily. The garrison's physical separation from the theater would make assimilating theater-produced intelligence more difficult. Analysts, interrogators, and other intelligence specialists in the theater would not be physically present to discuss their results with personnel in the CONUS.

Mitigation

Incorporating theater-produced intelligence, like some of the other difficulties facing reachback operations, is primarily a problem of communications. Other portions of this paper already described today's impressive datalinks, as well as the future's exponentially

increasing communications capabilities. The present discussion points out that data transfer is a two way process, so the theater must be suitably equipped to digitize and send data back to the garrison, just as the CONUS garrison must send data forward. As an added benefit, if the garrison receives all the theater's intelligence, the security consequences of damage to or evacuation of the deployed segment would be mitigated. In the event of an evacuation, the deployed segment's personnel could erase the electronic data stored in the JAOC with a few emergency software commands, because they would be secure in the knowledge that the garrison retained a complete backup.

Technology could also mitigate the problems of physically separating intelligence team members. Video teleconferencing could reduce the barriers to interacting with the theater's analysts and other specialists producing intelligence. True, the theater's day crew may have to interact with the garrison's night crew, but with thoughtful scheduling of shifts, much productive work could be done. Ultimately, to maintain situation awareness, theater data must be shipped back to the United States and national-source data must be shipped forward to the theater. Neither task seems insurmountable, or even particularly difficult, with the capacity, robustness, and security of today's communications capabilities.

Summary

A reachback operations concept does present difficulties, some due to human proclivities, others due to physical limitations. Fortunately, mitigating possibilities exist for nearly all of these challenges. More importantly, no overwhelming obstacles are

evident. However, successfully implementing a reachback system will require attention to the areas addressed in this chapter.

Notes

[1] Richard A. Stubbing with Richard A. Mendel, *The Defense Game,* (New York: Harper and Row, 1986), 110.

[2] Lucius Aemilius Paulus, quoted in Alfred C. Schlesinger, trans., *Livy,* vol. 13 (Cambridge, Mass.: Harvard University Press, 1951), 161-3. The entire passage is instructive of Paulus' point, and so is reproduced here: "In all the clubs and even—God save us!—at dinner tables there are experts who lead armies to Macedonia, who know where camp should be pitched, what places should be held with garrisons, when or by what pass Macedonia should be invaded, where granaries should be set up, by what routes on land or sea provisions should be supplied, when we must join battle with the enemy and when it is better to remain inactive. Not only do they decide what should be done, but when anything is done contrary to their opinion, they accuse the consul as if he were in the dock. Such behavior is a great obstacle to the men in the field. For not everyone is as unwavering and as steadfast of spirit against hostile gossip as was Quintus Fabius, who preferred to have his independence of command lessened by popular folly rather than to neglect the best interests of the state for the sake of acclaim. I am not, fellow citizens, one who believes that no advice may be given to leaders; nay rather I judge him to be not a sage, but haughty, who conducts everything according to his own opinion alone. What therefore is my conclusion? Generals should receive advice, in the first place from the experts who are both specially skilled in military matters and have learned from experience; secondly, from those who are on the scene of action, who see the terrain, the enemy, the fitness of the occasion, who are sharers in the danger, as it were aboard the same vessel. Thus, if there is anyone who is confident that he can advise me as to the best advantage of the state in this campaign which I am about to conduct, let him not refuse his services to the state, but come with me into Macedonia. I will furnish him with his sea-passage, with a horse, a tent, and even travel-funds. If anyone is reluctant to do this and prefers the leisure of the city to the hardships of campaigning, let him not steer the ship from on shore. The city [Rome] itself provides enough subjects for conversation; let him confine his garrulity to these; and let him be aware that I shall be satisfied with the advice originating in camp."

[3] Michael R. Gordon and General Bernard E Trainor, *The Generals' War,* (Boston, Mass.: Little, Brown and Co., 1995), 326.

[4] Ibid.

[5] JSSC class discussion.

[6] Fairchild.

[7] AGOS CD-ROM.

[8] Maj Bruce M. DeBlois, instructor at the School of Advanced Airpower Studies, Maxwell AFB, Ala., written comments to the author, 24 February 1997.

[9] Presumably, real-world contingencies would automatically take precedence over exercises, so no resource conflicts should arise between contingencies and exercises.

Notes

[10] Croker interview. Due to the coarseness of these figures, the manning estimates of 800 personnel in the garrison and 100 personnel deployed in the theater have not been adjusted to account for inefficiencies in operations. All such estimates should be viewed as merely illustrating the possible manning levels for a reachback system. A detailed concept of operations must be created before more confident manning estimates are possible.

[11] Ibid.

[12] Stansfield Turner, *Secrecy and Democracy: The CIA in Transition,* (New York: Harper and Row, 1985), 91.

Chapter 6

Conclusions and Recommendations

Finis coronat opus The end crowns the wok.

—Latin Saying

Conclusions

Desert Storm is certainly not the only conflict with lessons to teach, but being so recent, the lessons are perhaps a little fresher, and bear a bit more urgency. Many innovations for air campaign planning and execution first proved their worth during this war. Perhaps most notable is the fundamental concept that a joint air campaign is not only feasible, but is also a powerful means to decimate an enemy's warfighting ability. However, the complex process of synchronizing a massive, prolonged air effort during Desert Storm also taught another lesson. "Paper charts and grease pencils" are no longer the tools of choice. In the future, the JFACC must rely on sophisticated computer tools as well as a highly trained JAOC staff to choreograph an extensive air campaign.

To assist the air campaign, CTAPS provides a number of integrated computer tools to partially automate every phase of the ATO cycle. CTAPS evolved from its designers' fledgling efforts into the powerful capability it is today. Moreover, CTAPS continues to evolve as new information technologies offer performance possibilities unattainable even a short time ago. Two of these technologies are advanced communications and

geographically distributed data processing. Together, they make possible a new concept for air campaign planning and execution, namely reachback operations.

For many reasons, the JFACC, the senior JAOC staff, and liaison officers must deploy to the theater to fight the air war. However, a reachback system could allow between 50 and 70 percent of the JAOC's equipment, and almost 90 percent of its personnel, to remain in a garrison, either in the CONUS, or in another protected rear area. The equipment and personnel could still be linked electronically to the JAOC in theater with no loss of effectiveness. The reachback concept would entail far fewer survivability, deployability, and supportability concerns. Other ancillary benefits would also accrue from such an architecture in the areas of: database standardization, support for the JFACC afloat, transition between JFACCs afloat and ashore, operator proficiency, and configuration control.

Of course, reachback operations suffer some disadvantages as well, particularly in the areas of: senior officer reservations, dependence on communications, decreased operational efficiency, JFACC leadership of garrisoned personnel, and theater-produced intelligence. Fortunately, none of these disadvantages appears overwhelming.

In sum, the reachback system is a compelling next step in the evolution toward more effective computer tools for planning and executing air campaigns.

Recommendations

To enhance future JAOCs with reachback capabilities, a number of actions are required. Since this is clearly a multiservice issue, **the DOD should:**

1. **direct joint doctrine development groups to mature the reachback operations concept and codify it in joint doctrine.** Reachback operations offer an abundance of opportunities. This paper addresses only the most obvious advantages achievable by a reachback system. A mature reachback operations concept should also explore additional possibilities, such as a CONUS garrison becoming a robust communications node. More importantly, an approved joint doctrine should guide reachback system development.

2. **approve resources to implement reachback operations for the JAOC.** Unfunded policies are generally ineffective. Adequate funding, guided by an approved joint operations concept, is essential for tomorrow's JAOC to benefit from reachback operations.

3. **advocate a master database for all warfighting information needed by the JFACC.** The subject of a master database can be either a dream or a nightmare. Much thought must be given to both current implementation and future expandability. By definition, a master database must contain information needed by all services, not just one, so joint sponsorship is mandatory for this aspect of reachback operations to germinate.

4. **fund investments in technologies and systems for global connectivity.** This recommendation is an easy one, included primarily for completeness. The DOD is already investing heavily in communications technologies and systems, driven by the enormous force multiplication such systems offer the warfighter.

5. **continue to sponsor the DARPA research program "JFACC After Next,"** **until a service begins to fund this program.** Actually, the "JFACC After Next" program goes beyond the near-term reachback capabilities advocated by this paper. The

DARPA effort is also pioneering technologies for real-time ATO generation. Nevertheless, the distributed data processing aspects of "JFACC After Next" contribute directly to this paper's proposed system, and other aspects of the DARPA program fit nicely into CTAPS' continuing long-term evolution.

As the lead service for developing air power, the Air Force must play a key part in fielding a joint capability for air campaign planning and execution. Specifically, **the Air Force should:**

1. **Assist the DOD effort to develop joint doctrine for reachback operations.** As noted above, doctrine for reachback operations requires much thought. The Air Force has many years of experience relevant to this subject. Developing a reachback system is not enough; developing doctrine to guide both the system developers and the warfighters is just as important. The Air Force's new Command and Control Battlelab at Hurlburt Field, Florida, should play a valuable role in formulating joint doctrine for reachback operations.

2. **In the words of the Air Force Scientific Advisory Board, "take active ownership of the DARPA 'JFACC After Next' ACTD [Advanced Concept Technology Demonstration]."[1]** DARPA judges the worth of its programs based on service interest as expressed by funding commitments. "JFACC After Next" supports an important Air Force mission area. Air Force ownership of this program will assure continued emphasis on improving air campaign planning and execution.

3. **Plan, program, budget, and manage a procurement to field the first phase of a reachback capability by the year 2000, then field phases two and three when the concept of operation is mature, and interoperability with other systems is proven**.

Finally, the Air Force should incorporate evolutionary improvements from the "JFACC After Next" program when available. A reachback capability is urgently needed, so waiting for technologies still being developed before fielding a system is not in the national interest. The United States can field a prototype reachback capability by the year 2000, paced by the Global Broadcast Service's development schedule. Consistent with the nature of data processing and communication technologies, a near-term procurement should be structured to incorporate evolutionary improvements seamlessly.

4. **Act as the lead service for efforts to create a master database for the JFACC.** Such a complex and controversial undertaking as creating a master database for employing air forces needs the energetic leadership of the Air Force to be successful.

5. **Invest in technologies and systems for global connectivity, particularly by developing interfaces connecting the reachback system to other Air Force warfighting systems.** The Air Force understands the force multiplier potential of global connectivity. Investments in this area should continue, including investments in systems and interfaces assuring connectivity with the reachback garrison.

As mentioned above, the reachback operations concept is a joint concept. Consequently, other services, particularly the Navy, have important roles to play in fielding this capability. **The other military services should:**

1. **Assist the DOD effort to develop joint doctrine for reachback operations.** All services, not just the Air Force, have much to contribute in formulating doctrine for a reachback capability. The resulting doctrine's robustness will be proportional to the level of multiservice involvement.

2. **Plan, program, budget, and manage programs required to upgrade service-specific systems (for example, the Navy's command and control ships) to interoperate with a reachback system.** As this paper briefly explores, a reachback garrison could dramatically increase the JFACC's capabilities aboard ship. In addition, although not explored in this paper, strategic and tactical roles for Army aviation may also benefit from a reachback capability. However, some investments are necessary to assure interoperability with the reachback garrison.

3. **Assist Air Force efforts to create a master database for the JFACC, and ensure service-specific legacy systems can interoperate with this database.** Information is a precious resource, but its value will be unrealized if warfighters cannot access, use, update, and store the information they need. All services must assist in creating this master database, otherwise the plethora of today's databases will remain pretty much as they are now, fragmented and service specific.

4. **Support investments in technologies and systems for global connectivity, particularly by developing interfaces connecting the reachback system to service-specific systems:** Like the Air Force, the other services must modify their command and control systems to be interoperable with both the reachback system's deployed segment and its garrison. Such investments would allow the services to leverage their own warfighting capabilities by taking advantage of reachback operations' coordinating potential.

In an era of arduous fiscal constraints, the above tasks will be difficult, but the case for reachback operations is compelling, given the DOD's new vision of depending upon

easily deployable and overwhelmingly lethal forces to fight future conflicts. Reachback capability is truly a concept whose time has come.

Notes

[1] Air Force Scientific Advisory Board, 13.

Glossary

ACO	Airspace Control Order
ACTD	Advanced Concept Technology Demonstration
ADS	Airspace Deconfliction System
AFB	Air Force Base
AFCEA	Armed Forces Communications and Electronics Association
AGOS	Air Ground Operations School, Hurlburt Field, Florida
AOC	Air Operations Center
APS	Advanced Planning System
ATO	Air Tasking Order
CAFMSX	Computer Aided Force Management System - X
CD-ROM	Compact Disc-Read Only Memory
CENTAF	Air Force Component of the United States Central Command
CIS	Combat Intelligence System
CINC	Commander-in-Chief
COMM	Communications
CONUS	Continental United States
CTAPS	Contingency Theater Automated Planning System
DARPA	Defense Advanced Research Projects Agency
DAOC	Distributed Air Operations Center
DOD	Department of Defense
EHF	Extremely High Frequency
FLEX	Force Level Execution
INMARSAT	International Maritime Satellite
INTEL	Intelligence
JAOC	Joint Air Operations Center
JFACC	Joint Forces Air Component Commander
JFC	Joint Forces Commander
JIPTL	Joint Integrated Prioritized Target List
Joint STARS	Joint Surveillance Target Attack Radar System
JPT	Joint Forces Air Component Commander Planning Tool
JSSC	Joint Air Operations Senior Staff Course, taught at the AGOS
LOS	Line of Sight
MAAP	Master Air Attack Plan
OPS	Operations
RAAP	Rapid Application of Airpower
SATCOM	Satellite Communications
SHF	Super High Frequency

SINCGARS	Single Channel Ground and Air Radio System
SPINS	Special Instructions
UHF	Ultra High Frequency
US	United States
USA	United States of America
USAF	United States Air Force
USCENTCOM	United States Central Command
USS	United States Ship

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